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The prediction of energy state in California based on time series

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Abstract. In order to determine the optimal energy profile in California (CA), this paper applies two basic models to data mining based on the simple processing of the given data, so as to analyse the trend and predict the future effect, and then put forward a solution by integrating a variety of influencing factors. First of all, through data analysis and multiple regression model, we get the specific evolution of CA from 1960 to 2009 from two aspects about energy consumption and clean energy consumption. Through the analysis of this specific evolution, the total energy profile, clean energy profile can be obtained respectively. Secondly, based on the evolution trend of the relationship between energy production, energy consumption and clean energy consumption from 1960 to 2009, we used the ARMA model in time series analysis to fit the data and predict the future energy consumption situation. Finally, taking all these factors into account, the clean energy use targets for 2025 and 2050 were set and three proposals for action were made for CA.

Keywords. Clean energy, energy utilization.

1. Introduction

Energy is an important material basis for economic growth and social development. There are many factors that affect the production and use of energy in a region, including geographical location, climatic conditions, industrial structure and so on. In the United States, energy policies vary from state to state. To be more specific, we take CA as an example to analyze.

The solution proposed in this paper will obtain the energy profiles of CA, describe the development of the energy situation of it from 1960 to 2009, its energy consumption outline, and predict the energy profiles of CA in 2025 and 2050, and finally propose three actions to CA's Ministry of Energy by combining various factors.

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2. Model One: Build the energy state model by Multiple Regression Analysis

2.1. Energy Consumption.

2.1.1. Total energy consumption. Proportion of energy consumption in each sector to total energy consumption

Table 1. Description of Label

TEACB	Total energy consumed by the transportation sector.
ESTXB	Electricity total end-use consumption (i.e., sold).
TERCB	Total energy consumed by the residential sector.
TECCB	Total energy consumed by the commercial sector.
TEICB	Total energy consumed by the industrial sector.
TETPV	Total energy expenditures per capita.
TETCV	Total energy expenditures.
TPOPP	Resident population including Armed Forces.
TEPRB	Total energy production.
TETCB	Total energy consumption.

In order to obtain the energy consumption ratio of each department, make TEACB, ESTXB, TERCB, TECCB and TEICB divide with SUM (SUM= TEACB+ ESTXB+ TERCB+ TECCB+ TEICB) to obtain:

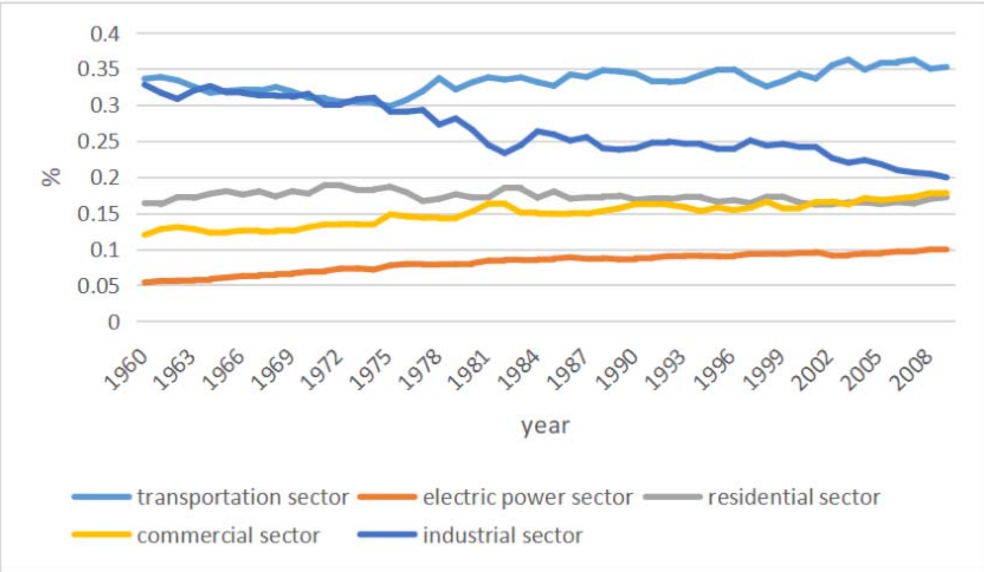

Fig. 1 Share of energy consumption in each sector

Transportation and industrial sectors consume large amounts of energy and the electricity sector consumes small amounts of energy. The share of the transport sector increased while the share of the industrial sector declined.

Effect of total energy expenditure and resident population on energy consumption per capita.
Firstly, we analyzed the influence in California. Using SPSS software for regression analysis [1]:

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	382.966	35.381		10.824	.000
	TETCV	.025	.001	.989	41.348	.000
2	(Constant)	654.038	168.782		3.875	.000
	TETCV	.027	.001	1.069	19.717	.000
	TPOPP	-.013	.008	-.089	-1.641	.109

a. Dependent Variable: TETPV

Fig. 2 The result of regression analysis about TETPV in CA

From this graph, it can be seen that the total energy output is proportional to the per capita energy consumption.

$$TETPV=0.27TETCV-0.013TPOPP+654.038$$

2.1.2. Clean Energy Consumption. Trends in clean energy consumption as a percentage of total energy consumption

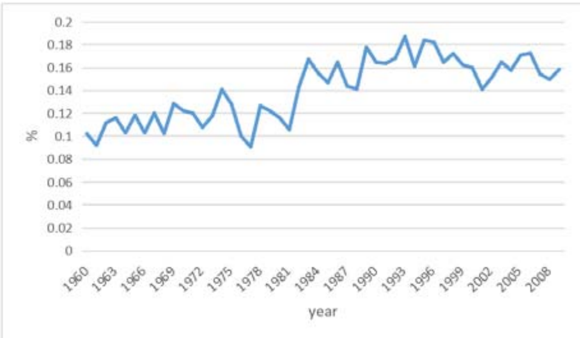

Fig. 3 Proportion of clean energy consumption to total consumption

From this figure, we can see that clean energy consumption in general is relatively small, but it has a rising trend.

Share of clean energy use

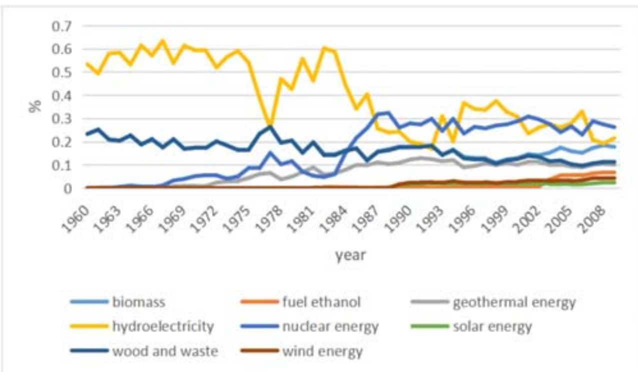

Fig. 4 Share of clean energy use

large proportion of water resources, other average distribution. And the proportion of water conservancy decreased, nuclear energy and geothermal energy accounted for a rising trend.

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2.2. Model Analysis.

2.2.1. Energy profile. Analysis of the given data, from consumption, and clean energy two aspects of CA are summarized in the energy profile.

In terms of total energy consumption, the transport sector and the industrial sector accounted for a large proportion, the power sector is small, and the industrial sector accounted for a downward trend, the transport sector to maintain a certain. About clean energy, hydropower accounts for the largest share of clean energy. The proportion of clean energy in total energy consumption is small, but the overall trend is upward.

2.2.2. Overview of clean energy. CA accounted for a large proportion of water. The proportion of geothermal energy in CA has increased. The proportion of CA.

Different reasons

As shown, this is an overview of the number of volcanoes in this four States [2]:

Table 2. The factors

States	Number	GDP	%
California	20	51733	79
Arizona	3	38232	85
New Mexico	4	40670	76
Texas	0	47034	61

The number of volcanoes represents the abundance of geothermal energy. This shows that California has more geothermal energy than the other three States, so California consumes more geothermal energy than the other three States.

3. Model Two: Predict future energy conditions by Time Series Analysis

3.1. Model Construction.

Objective things have a continuous rule of development, things in the past will also continue to the future. At the same time, the randomness caused by accidental factors will also affect the development of things in the future.

In order to eliminate the influence of random fluctuation, we make statistical analysis based on the past time data to infer the development trend of things in the future.Based on SPSS software[3], we use autoregressive sliding and mixed model ARMA in time series analysis to solve this problem. We used historical data to carry out statistical analysis, and do appropriate processing to the data, so as to forecast the trend.

3.2. Model Analysis.

Using ARMA model [4], fit a curve to the data of total energy production (te prb) and total energy consumption (Tet CB) from 1960 to 2009 in California, and the production and consumption in 2025 and 2050 were predicted. A region in a certain period of time the ratio of total energy production and total energy consumption, known as the energy surplus coefficient. the final data as shown in the table below:

Table 3. Forecast in 2025 and 2050

CA		2025	2050
TEPRB	Forecast	2596957	2583903
	UCL	3633748	4243579
	LCL	1560166	924227
TETCB	Forecast	9492483	11815871
	UCL	10867316	14016677
	LCL	8117650	9615064
Energy surplus coefficient		0.27358	0.218681

Projections for 2025

In CA, geothermal energy, solar energy, fuel ethanol and biomass energy consumption are high, and these should reach the range of [127461,220345], [41649,64988]and [80473,168497] billion Btu respectively.

Projections for 2050

In CA, geothermal energy, solar energy and fuel ethanol shall reach the range of [127461,244147], [57668,95029]and [80473,225664] billion Btu respectively.

4. Actions to Meet the Goals

CA has more experience in clean energy consumption, so it should communicate with the other regions to teach them the experience and impact of clean energy use and development actively. In addition, CA's professionals can also visit three other regions to provide some guidance on their clean energy development direction.

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