



## *Rationalization of Energy by Using Prepaid Devices: Najaf City as A Model*

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### *Abstract*

Increasing demands of electric power recently has pushed the government to find multiple solutions that force the consumer to use energy an optimal utilization and rationalize it. The main aim of this paper is to improve customer acceptability of Prepaid Meters and determine management strategy in promoting prepaid usage. Though, this solution did not meet the required purpose. In this sense, this paper focuses on: (a) establishing the culture of concern for public money, (b) launching of the largest and widest process of rationalization of energy consumption by the consumer and not by the product only, (c) obtaining production costs immediately through the use of pre-payment devices. One of the major findings of this paper is that the rationalization of energy by 1% of the daily consumption of the citizens, will provide approximately 4 megawatts for the province.

**Keywords-** Energy Save; Rationalization; Prepaid Meters; An Electric Management Strategy.

### **1. Introduction**

The need for electrical power is dramatically increasing as a result of the trend to use modern technological means and methods, to meet the daily needs in order to improve life patterns. This has led to the widespread use of a lot of modern electrical appliances, whether in homes or places of work, such as air conditioners, washing machines, dishwashers, dryers, blenders, televisions, receivers and computers. Additionally, lighting is regarded as the main consumer in the low consumption devices in homes. However, electrical appliances are regarded the main consumers in the high consumption devices in this sector, which could affect the increase of the electricity bill value. Therefore, the energy must be consumed with more efficient manner, which clearly covers at least two related troubles. First is to improve access of infrastructure services. This challenge stimulates the private sector involvement, industry restructuring and other subsequent regulatory reforms.



Second is to create the cost-reflective tariffs. This challenge stems from the goal of economic efficiency to make sure that consumers can bear the services. These concerns prompted the companies and regulators to determine the technological and regulatory options that aim to promote access of consumers to pay for their services and make it easier. In both cases, Latin America has been a pioneer in adopting innovative mechanisms. In the first case, it was encouraged to obtain higher rates of services through the establishment of community participation, small credit programs, and the use of modern technologies. In the second case, it has sought to raise the affordability through the use of tools that ease the burden of bills by reducing the cost and using an alternative means of payment <sup>[1]</sup>.

The main objective of this paper is to find strategies to promote the acceptance of customers to the mechanics of prepaid and handling.

Electrical power is produced in most cases by using fossil fuels (oil and its derivatives, 82%) <sup>[2]</sup>, which requires non-draining and preserving for future generations. Thus, the need has called the advanced and developed countries, to implement programs raising the efficiency of energy supply (production, transport and distribution) <sup>[2]</sup>.

The rest of this paper is organized as follows: Section 2 provides the necessary sources of energy, ways of acquiring them and their types. Section 3 describes detailed study of electric power and its consumption and collection in Najaf during September 2016. Power distribution in Najaf (3.1), and electricity revenues (3.2). Section 4 shows implementation of traditional and pre-payment mechanism. Section 5 gives the results and discussion of the squatters on the electric power grid in Al-Najaf province. Section 6 explains how to rationalize the consumption of electric power. Finally, Section 7 concludes the paper in addition to practical recommendations.

## 2. Sources of Energy, Ways of Acquiring them, and their Types

Energy is one of the main components of civilized societies and needs by all sectors of society. Energy is the capacity to do work. In addition to the urgent need to in the conduct of daily life as it is used in the operation of factories and moving the several means of transport and the operation of home appliances and other. Internationally, there is an boost demand for energy, especially electrical energy. Oil prices increasing not only that but pollution continues to rise because of burning of fossil fuels, and the probability of oil supply depletion remains.

To understand the power, it must know the sources and limits, and their uses. To develop a good and effective policy, it must identify the



amount of energy produced and the range of permanence and continuity. The answer to these questions is not easy because it depends on future consequences for the extraction of these resources, amount of consumption and energy prices <sup>[3]</sup>.

Primary energy is taken directly from the environment, while the secondary energy transformed from the primary energy in the form of electricity or fuel. Distinguishing primary and secondary energy sources is significant in the energy balances to count and record energy supply, losses and transformations <sup>[4]</sup>.

Three distinguishing groups of primary energy are:

- Nonrenewable energy (fossil fuels): coal, crude oil, natural gas and nuclear fuel.
- Renewable energy: solar energy, wind, hydropower, geothermal, ocean energy and biomass.
- Waste.

### 2.1 Non-renewable Sources

A non-renewable resource is a resource of economic value that cannot be readily changed by natural means on a level equal to its consumption <sup>[5]</sup>.

1- Fossil sources which come from the earth and are of three types:

A- Oil (which Iraq depends on).

B- Gas (one of the sources which Iraq is spreading in use.)

C- Coal (not supported in Iraq).

2- Nuclear sources (not supported in Iraq).

### 2.2 Renewable Sources

Renewable energy generally sets as energy that is composed of resources which are naturally replenished on a human timescale, such as rain, sunlight, tides, wind, waves and geothermal heat.

Renewable energy almost provides energy in four cases: electricity generation, water and air heating/ cooling, transportation, and rural energy services <sup>[6]</sup>.

Renewable energy resources occur over wide geographical areas, in contrast to other energy sources, which are concentrated in a limited number of countries. Rapid deployment of renewable energy results in significant energy security, climate change mitigation and economic benefits <sup>[7]</sup>.



- Water resources (one of the sources available in Iraq, with the possibility of development and reliability).
- Biofuels (considered one of the important sources that are potential candidates for adoption when conditions are suitable).
- Solar energy (which is one of the important sources that are potential candidates for adoption when conditions are suitable).
- Wind power (which is one of the important sources that are potential candidates for adoption when conditions are suitable).
- Tidal power (not supported in Iraq).

The amount and the importance of energy is a known fact to all, so this paper expresses that and devotes efforts to find alternatives to the early concerns in countries worldwide or their institutes and research centers <sup>[8]</sup>.

The burning of oil, gas or coal, or using a nuclear reactor to heat water and turn it into steam which then rotates turbines, generates one of the main forms of energy, namely electric power, which is regarded today as a non-efficient process.

On the other hand, the efficiency ratio ranges from 35-80% from a non-renewable resource. As for renewable energy in generating electricity, for example, from the sun or wind or water resources, they are of highly efficient range of 60-85%. This is new today in most countries of the world having benefits and correct rules that underpin it and its audience, with regard to it as the green energy.

Iraq is a member of the Organization of Petroleum Exporting Countries (OPEC) and covers an area in excess of 430,000 km<sup>2</sup> and the amounts of fuel used in the power stations on 2016 are (8936) million liter of Crude oil, (4397) million liter of Fuel oil, (248) million liter of Diesel oil, (962) million liter of Gas oil and (6166) million liter of Natural gas. The proportion of fuel use (oil and its derivatives) in power stations on 2010, 2011, 2012 and 2016 are shown in Figure 1.

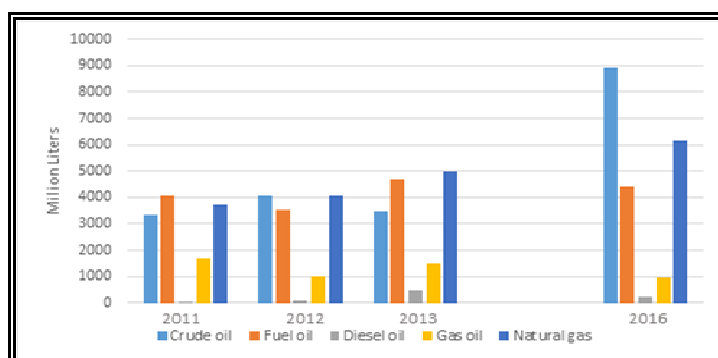


Fig. 1- Fuel consumption





The amount of produced energy (Iraqi power stations) for 2016 is (9240) Megawatt, and the amount of imported energy is (13104) Megawatt. Total energy (produced and imported energy) to the consumers from 2010- 2016 are show in Figure 2. The amount of carbon dioxide emissions by the power stations in 2012 are (187 million ton) and in 2016 approximately (481 million ton) <sup>[3]</sup>.

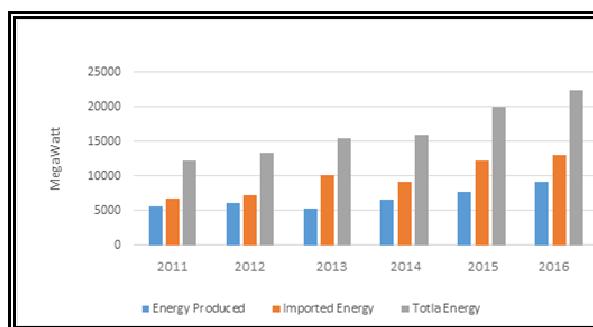


Fig. 2 - Total energy (produced & imported)

The applicable tariff achieved in 2016 revenues of (824 billion ID) for energy sold to the consumers, the quantity was around 42 million Mega Watt; while there has been real cost amount (4455 billion ID) <sup>[2]</sup>.

In reality, the generation of electrical energy (renewable and non-renewable) in Iraq are exposed to extreme abuse in usage. It doesn't matter how much these sources increased or expanded volume of production, the control of the consumption is difficult and often is impossible in Iraq, which are witnessing a continuous turmoil in their growth. The electric power is a reference to a major artery of the infrastructure to build the country (countries). Whenever the country reaches efficiency in its production and consumption, it will bridge the gap to begin production and turnover of the wheel. In this sense, this paper refers to the important and radical solutions by specialized technology in the field of information and smart applications.

### 3. Electric Power Consumption and its Collection in Najaf during September 2016:

#### A Detailed Study

This paper gathers data on the number of electricity consumers and transgressors in the province. Besides, how to collect money from the distribution of electric power to the consumers in favor of the government using traditional methods? As well as putting forth virtual alternatives to deal with cases of energy waste/ rationalization.



### 3.1 Power Distribution in Najaf

The number of registered subscribers on September 2016 in Najaf province is around 172 thousand for a single or three-phase connection according to the load or receiving request. **Table 1** and Figure 3 shows the division of those subscriptions <sup>[9]</sup>.

**TABLE 1:** Subscriptions Division

No. of registered subscribers	Subscription type
146,422	Home subscriptions
14,930	Commercial subscriptions
2,288	Industrial subscriptions
2,014	Agricultural subscriptions
6,283	Government departments subscriptions

The total energy supplied by the central government to the subscribers has reached 400 megawatts/ hour on September, 2016 <sup>[10]</sup>. The power supply depends on the atmospheric changes of hot and cold in the peak load. An estimated energy needed for the Najaf province is 800 megawatt/ hour in summer season.

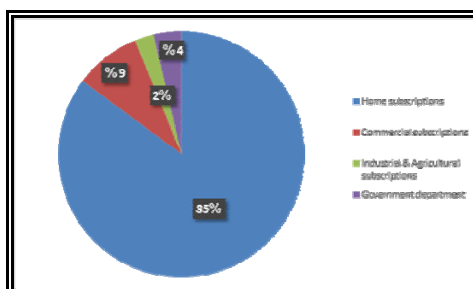


Fig. 3 - Power distribution on subscribers

### 3.2 Electric Energy Revenues

The tariff obtained from the participants (kilowatt/hour price) varies in price according to the consumed energy by the subscriber for one month and for all varieties. **Table 2** shows revenues of the electricity <sup>[10]</sup>.

**Table 2:** Electrical Energy Revenues

Number (Units)	Price (ID)
<b>Home subscriptions</b>	
1- 1500	10
1501- 3000	35
3001- 4000	80
4001 and above	120
<b>Commercial subscriptions</b>	
1- 1000	60
1001- 2000	80
2001 and above	120
<b>Industrial, Agricultural, and Government departments subscriptions</b>	
All units	120
<b>1 USD \$ = 1200 ID</b>	



The prices are not equal to all subscriptions (houses, Commercial shops, factories, farms and Government departments) <sup>[2]</sup>.

Since the processed amount of energy to the province is 413 Megawatts in September 2016, so the amount levied imposed from the subscribers is 3,223 billion ID, while the verified (the amount levied by the enumerators and the main collection stations in the city) is 1,559 billion ID <sup>[9]</sup>.

In other words, the proportion of collection (payment by the consumer) is 48% with a load amount of 1,663 billion ID. This amount is added to the amounts retained from the previous months. Thus, the value of retained amounts for the previous months become (debt owed by consumers) 73,896 billion ID, Figure 4 shows the collected, spinner and imposed amount details <sup>[9]</sup>..

Billion ID	73.

Fig. 4 - Collection with retained amount

#### 4. Implementation of Pre-payment Mechanism

Pre-paid metering has been in the market as a ready option for consumers in many countries abroad. Prepayment metering system has slowly and gradually started to gain foothold in power sector scenario in Iraq. At last few years, various utilities have been embarked upon the journey of prepayment metering system with due approval from the Ministry of Electricity in Iraq.

##### 4.1 Traditional Payment Mechanism

The accumulation of debt owed by consumers, whether citizens, factories, and private or governmental institutions, have several reasons and causes which can be figured out by understanding how to read convention all measures by means of enumerators and methods of collection and payment.

The scale reader (meter) is an employee of the state and is limited by official working time. This causes difficulty in reading most of the standards for homes and institutions due to the absence of homeowners at



times. Therefore, the calculation of the consumption value is often speculative. The percentage of reading at best reaches up to 85%, which is mostly speculative. In addition, the difficulty in payment by the consumer within the times specified for payment due to the fact that most customers depend on their monthly income, which is contrary to the date of payment or the scale reader's visit and the figure 5 illustrates the flowchart of issuing electricity list from the counter down to the customer<sup>[11]</sup>.

Distribution diagram lists from the sales department to the sectors is illustrated in figure 6 below<sup>[11]</sup>.

The method of obtaining funds is done through location collection by the counter or through citizen's payment to the collection centers in sectors or even by checks. Scale reading is explained in the electricity paper, which is the number of units disbursed by the subscriber and read by the reader machine (counter). The number of issued lists are (84014) for September. In case of the payment omission in the specified period, the following measures are taken:

1. Cut off the electricity until payment.
2. Otherwise (in case of payment refusal), a lawsuit is held for the purpose of obtaining money.

Currently, the traditional system is used in the province which is based on the idea of the meter. The meter contains an aluminum disk, on which there are two magnets field that separated by 90 degrees. One of them is generated by a coil that connects between the ends of the electrical entrance, which depends on the voltage. however the other is generated by a coil in which the current passes through as well as to the load. Thus the rotation speed is a function of the power consuming. This device can be easily manipulated using more than one way to reduce the amount of energy measured.



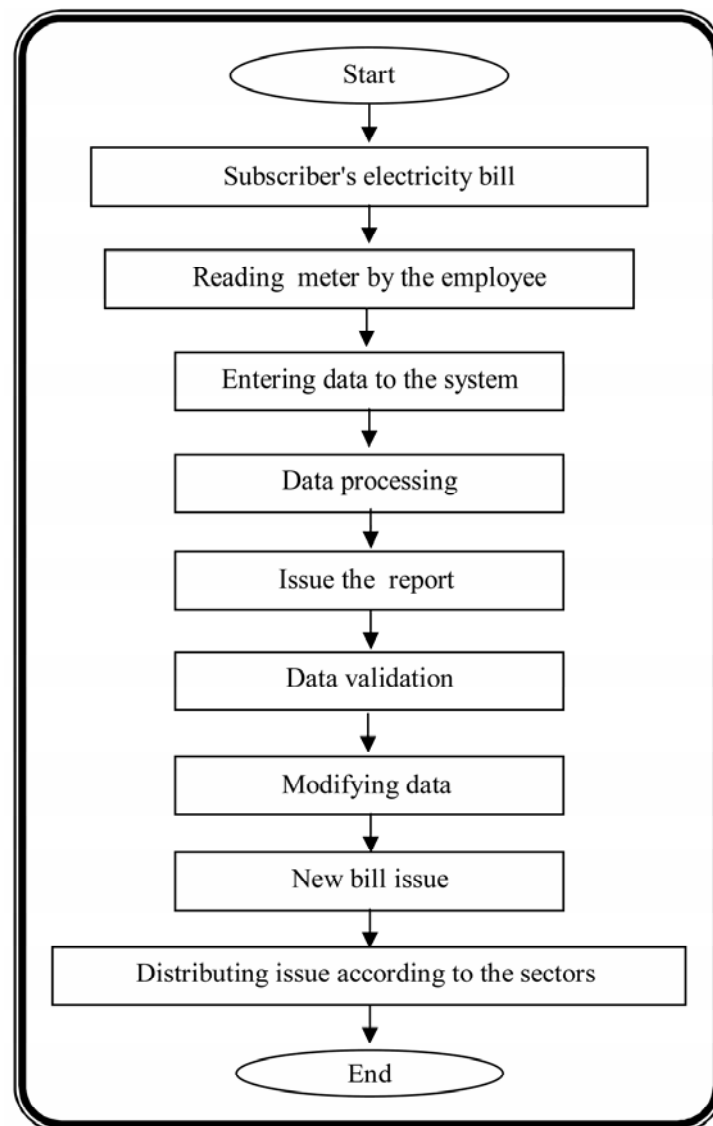


Fig. 5: Electricity list issue cycle.

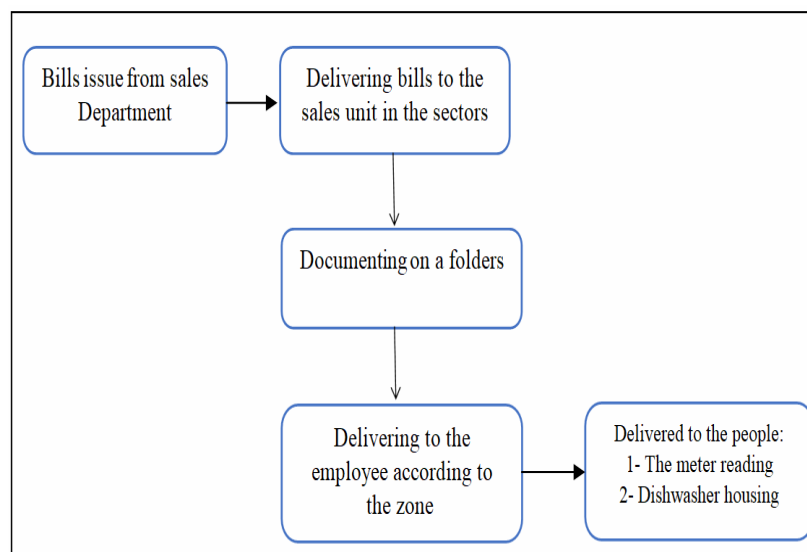


Fig. 6: Electricity list distribution diagram



Recently, the companies of electric distribution called for the introduction of smart meters to the provinces. These meters are able to store and display the information manually and automatically as well. Also, it can be connected to the computer through a compatible software via multi-touch systems or mobile devices. Furthermore, the possibility of reading meter from a distance about (50) meters without the need to enter the home or building. In addition to bearing high temperatures, humidity, dust-proof, rain-proof, and detects manipulation for about 200 cases of manipulation through flashing red warning light, recording time and date of occurrence. It is also distinguished by its high reliability and is not affected by magnetic fields, as well as the ease of reading information from the meter due to the presence of a back-lit screen. With the possibility of working under a single introductory for up to eight introductory which are regulated by the electric power consumption and peak time. Although the smart meters provide the necessary security solutions to the problem of manipulation and reading the meter locally, but it doesn't contribute in the rationalization process <sup>[12]</sup>.

#### 4.2 Prepayment

It is obligatory to begin the implementation of this project due to the growing complaint by the subscribers to the calculation of consumption value using the electricity meters in houses, as well as increasing the value of the electricity bills above the expected level. In addition, to the large benefits of prepayment devices in the rationalization of energy consumption rate, the users can consume electricity only after purchasing of electricity, and when the electricity purchased is finished, the power supply will be automatically cut off <sup>[13]</sup>.

The prepaid counters are distinguished by the feature of uninterrupted service in the case of running out of the value of pre-balance payment on public holidays and for a period of twenty-four hours, but the meter will work and calculates the value of negative depreciation. The value of additional consumption is deducted when the subscriber recharges his tally, where each home-owner can follow their consumption accurately, thus the system will force the consumer to rationalization. Additionally, it solves the problem of the difficulty of collecting electricity charges and therefore also solves the problems of workload on reading meters and collection of fees. Thus, the role of enumerators (scale readers) are limited to a supervisory role only.

#### 5. Transgressors on the Electric Power Grid

The phenomenon of overtaking on the electric power grid by taking power into shops and houses in the manner of robbery is a major obstacle to the maintenance of the stability of energy provision in the province, as



well as what these abuses cause of continuous power breakdowns in power cabins.

The number of total transgressors in Najaf, according to the report of September 2016, is 46395, Figure 7. The reason is tracked to the emergence of random cases and the lack of security, accountability, and conversion of agricultural land to residential land without consensus with the energy distribution of the region <sup>[14]</sup>.

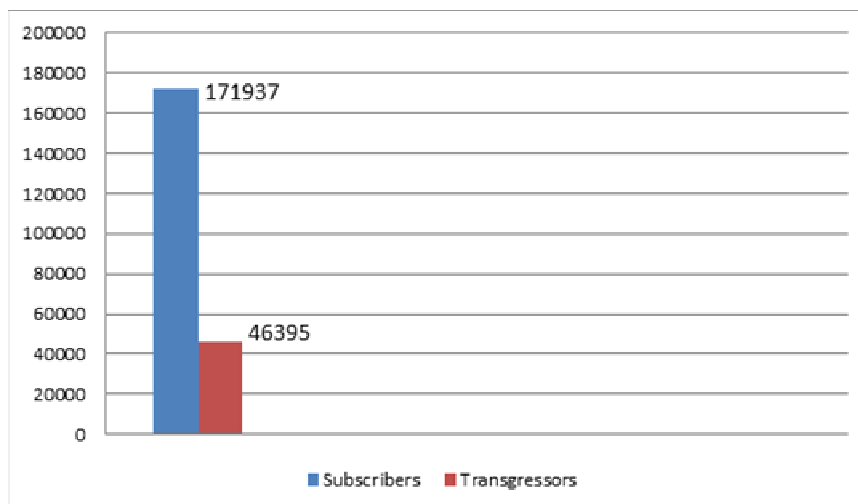


Fig. 7 - Subscribers and transgressors

The General Directorate of Middle Euphrates Electricity Distribution formed twenty groups, within the campaign of raising abuses and energy conservation on September, 2016, for the establishment of 14 lawsuit to the purpose of obtaining money from the transgressors. It released 259 ultimatum to save energy. The number of abuses which have been filed reached 791 cases in the various sectors of the province.

Najaf Electricity Distribution Company suffers from the cases of transgression and loss, which exceed 30% in most cases and its wages cannot be met taken. Wasted energy is visible in lighting poles in the streets, the grid lines and generators in the province and the random transgression cases.

## 6. Rationalization of Electricity Consumption

The rationalization of electricity consumption is not a restriction on the freedom to use electric power or compromising the efficiency of appliances and equipment. Nor does it mean the reduction of energy consumption, but the optimal consumption of electric power resources, thereby reducing wastage by relying on wise methods and measures in various sectors. There are several benefits to saving energy, including:



- 1- The optimum exploitation of energy resources, including oil and its derivatives, used in power plants.
- 2- Conservation of energy sources for future generations.
- 3- Reduction of necessary investments for the construction of stations and commission of their necessary maintenance.
- 4- Improving the environment by reducing greenhouse gas emissions.
- 5- Reducing the electric bill and thus reducing the financial burden.
- 6- Supporting the industry by providing the required quantities of energy and the development of the national economy.

A simple equation for energy savings, increased by 1% of the daily consumption of the citizens, it will provide approximately 4 megawatts for the province. This saved energy is enough to run several plants including the Ready-Made Clothes Factory, which needs less than 3 megawatts to run the plant in all its sectors, this plant which was founded in 1981 and with a production exceeding 220,000 pieces/month. in condition of sufficient quantity of electricity for the plant. The number of workers at the plant exceeded 1200 employees [15].

## 7. Conclusion

The importance of rationalization is summarized in the optimal consumption of fossil energy sources and preserving it for future generations, as well as the adoption of wise methods and measures for the optimal utilization of electric power, that leads to supporting the industry and developing the national economy. Also, state institutions play a big role in the responsibility for legislation, implementation and censorship next to the media and technical role in educating citizens of the importance and means of saving energy.

- Legislative; through developing laws that contribute to rationalization.
- Implementation; in the implementation of specific programs in the rationalization process and removing obstacles.
- Censorship; in monitoring the implementation of such decisions to assist in the rationalization.
- Technical; by introducing the rationalization technology for the optimize use of devices and electrical equipment.

## 8. Recommendations

- 1- Pre-payment devices should be applied because of their many benefits in:
  - Increasing the rationalization of energy.
  - Raise awareness among citizens and made them the first contributor to rationalization.



- Reduce the percentage of transgressors on the national network.
- Convert a lot of employees (collectors) into energy observers.
- 2- Continuity of providing support to the citizen by:
  - Installment of the amounts of equipment and linking and for a sufficient time.
  - Supporting the citizen by providing a system;

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