A Case Study on Energy Audit of the Public Institution

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Abstract. In 2016, China issued the “Interim Measures for the Administration of Energy Auditing of Public Institutions”. Energy audits of public institutions have received increasing attention and have been widely used. Through the energy audit, a public institution found that the energy management, the energy measurement and the energy statistics system have not been perfected. The transformer load rate is low. Moreover, there are high energy consumption and backward equipment existed. Therefore, the energy conservation proposals are put forward.

1. Introduction
With the rapid development of the economy, energy consumption has grown rapidly, causing serious resource and environmental problems. At the 2009 Copenhagen conference, China promised to significantly reduce carbon intensity and actively develop a low-carbon economy. In order to strengthen the energy conservation management of public institutions and standardize the energy audit work of public institutions, in 2016, China issued the “Interim Measures for the Administration of Energy Auditing of Public Institutions”. Energy audits of public institutions have received increasing attention and have been widely used.

2. Analysis of energy performance of public institutions
One public agency has about 3,200 employees and a building area of 40,000 m². Its energy consumption includes electricity, natural gas, gasoline, diesel and tap water. All energy sources are outsourced. The energy and resources used by public institutions are mainly electricity, natural gas, steam/diesel, and water. The power is used in various power supply areas after being transformed, mainly for power equipment, lighting, office and living areas, etc. Natural gas is mainly used for canteens and water heaters. Tap water is mainly used for office, districts, canteens, swimming pools, fire and green. Gasoline and diesel are mainly used in vehicles. The consumption of energy resources is shown in Table 1.

As can be seen from Table 1, the power consumption is the largest, accounting for 70.46%, followed by natural gas consumption, accounting for 12.50%, gasoline accounting for 15.36%, and diesel accounting for 1.68%.
Table 1 2017 energy and energy consumption

| Energy type   | Quantity | Unit    | Standard coefficient | Standard coal Value/tce | %   |
|--------------|----------|---------|-----------------------|-------------------------|-----|
| Electricity  | 100.22   | 10^4kW-h | 1.229                | 123.17                  | 70.46% |
| Natural gas  | 16434    | m³      | 1.3300               | 21.86                   | 12.50% |
| Gasoline     | 18.25    | t       | 1.4714               | 26.85                   | 15.36% |
| Diesel       | 2.01     | t       | 1.4571               | 2.93                    | 1.68%  |
| Water        | 32000    | m³      | ---                  | ---                     | ---    |
| Total        | ---      | ---     | 174.81               | 100%                    | ---    |

3. Comprehensive energy consumption comparison

In 2016, the total consumption power was 1,307,700kWh, natural gas was 17,641m³, gasoline was 20.85t, diesel was 3.58t, tap water was 81,053m³, and the total energy consumption was 220.07tce. In 2017, total electricity consumption was 1,022,000 kWh, natural gas was 16,434m³, gasoline was 18.25t, diesel was 2.01t, tap water was 32000m³ and total combined energy consumption was 174.81tce. The total combined energy consumption in 2017 is 11.89% less than that of 2016.

Table 2 Comprehensive energy consumption

| Items                              | Unit     | 2016   | 2017   | Growth rate /% |
|------------------------------------|----------|--------|--------|----------------|
| Electricity consumption            | 10^4kW-h | 130.77 | 100.22 | -23.36%        |
| Natural gas consumption            | m³       | 17641  | 16434  | -6.84%         |
| Gasoline consumption               | t        | 20.85  | 18.25  | -12.47%        |
| Diesel consumption                 | t        | 3.58   | 2.01   | -43.85%        |
| Water consumption                  | m³       | 81053  | 32000  | -60.52%        |
| Total consumption                  | tce      | 220.07 | 174.81 | -20.57%        |
| Comprehensive energy consumption/unit of building area | kgce/m² | 68.77 | 54.63 | -20.57% |
| Per capita comprehensive energy consumption | kgce/capita | 5.50 | 4.37 | -20.57% |

Table 3 Comparison electricity consumption between 2016 and 2017

| month | 2016 | 2017 |
|-------|------|------|
| 1     | 9.11 | 6.68 |
| 2     | 5.54 | 6.64 |
| 3     | 7.04 | 5.62 |
| 4     | 7.96 | 6.32 |
| 5     | 8.75 | 7.09 |
| 6     | 11.78| 11.52|
| 7     | 17.88| 12.38|
| 8     | 17.91| 13.15|
| 9     | 14.68| 11.95|
| 10    | 12.06| 8.59 |
| 11    | 11.12| 5.97 |
| 12    | 6.94 | 4.31 |
| Total | 130.77| 100.22|
4. Energy saving measures
In 2017, the public institution carried out a number of energy-saving projects such as energy-saving renovation of LED lamps, procurement of energy-saving products, renovation of canteen gas stoves, and renovation of aged water supply pipelines. The comprehensive energy consumption was reduced by 11.89% compared with 2016. The energy-saving effect was remarkable.

5. Conclusion and suggestion
Public institution energy audits help public institutions to use energy efficiency and save on fiscal expenditures. Through this audit, it is found that the energy management, energy measurement and energy statistics systems of a public institution have not been perfected. Therefore, there is room for improvement and improvement. For example, the transformer load rate is low, and there are high energy-consuming backward equipment.

For the problems found, the following energy saving suggestions are proposed:
(1) Energy conservation management. Firstly the management system of energy-using units should be improved. Secondly, the established energy management institutions and energy management systems should be sorted out. Thirdly, energy audits of public institutions should be conducted regularly. Fourthly, energy consumption indicators should be formulated. Fifthly, energy-saving and water-saving publicity should be strengthened.
(2) Energy measurement and energy statistics. Establish a sound energy measurement and energy statistics system and strengthen analysis.
(3) Energy saving system recommendations. Eliminate high-energy-consumption equipment, purchase new high-efficiency energy-saving products, and conduct detailed single-phase testing of key energy-using equipment.

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