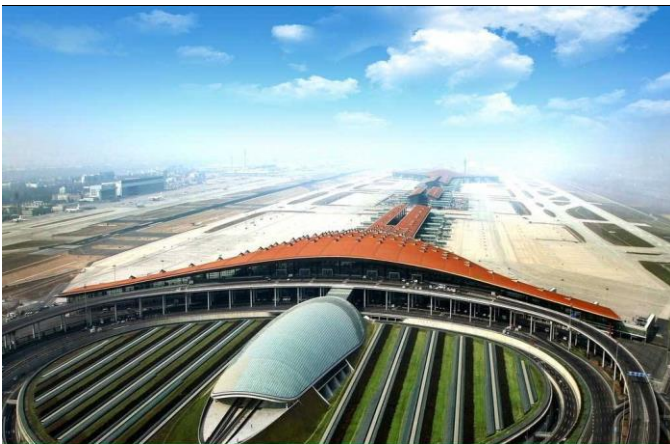


Global Energy Management System Implementation: Case Study

Beijing Capital International Airport Co., Ltd.

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The first domestic large-scale airport passing energy management system certificate.



EnMS in Beijing Capital International Airport

Business Case for Energy Management

Organization Profile / Business Case

As the “the First National Gate”, BCIA is an important window of China for external presentation. Its main energy consumption includes power, cold & hot water and steam. Its gross floor area exceeds 1.6 million square meters, and its comprehensive energy consumption in 2016 reached 119,700 tons of coal equivalent (tce).

Drivers: We should conscientiously carry out and implement relevant policies and policies of national energy conservation and emission reduction, fulfill social responsibilities and create a green country image, and strive to build ourselves in to a resource-saving and environment-friendly enterprise.

Organization: BCIA has set up a special team for energy conservation and consumption reduction with leaders participating in.

Energy management program: In 2014, Capital Airport became the first domestic large-scale airport got energy management system certificate, and in 2016, BCIA became the first inland enterprise obtaining Airport Carbon Accreditation certificate of Airports Council International.

Energy reduction approach:

- ① In beginning of the year, BCIA carried out the energy review and refine the assessment objectives & EnPI to various business departments.
- ② In the process of operation, the departments will strictly implement the energy-saving operation and continuously optimize the economical operation programs to effectively improve the energy efficiency of the system.
- ③ The departments will actively pay attention to and carefully analyze the energy data and report the results to the Company.
- ④ BCIA invests a lot of human and material resources in the energy-saving opportunities each year.



Figure 1 Searching for energy saving opportunities

“The implementation of the system provides an all-around view which can be the guide of energy management. EnMS is helpful to our energy management, as the Chinese proverb goes, ‘just like adding wings to a tiger’.”

---Hao Yongming, Division Manager of Technological Service Purchase Dept.

Business Benefits Achieved

Case Study Snapshot

| | |
|--|---|
| Industry | Airport |
| Product/Service | Aviation business; Non-aviation business |
| Location | Beijing, China |
| Energy Management System | GB/T 23331 (ISO 50001) |
| Energy Performance Improvement Period | 2014-2016 |
| Energy Performance Improvement (%) | 11.57% |
| Total energy cost savings over improvement period | over 3,100,000 USD / year |
| Cost to implement EnMS | Maintenance of the EnMS, 100,000 USD / year Implementation of Projects, 2,500,000 USD / year |
| Payback period (years) on EnMS implementation | 0.84 Years |
| Total Energy Savings over improvement period | 458,900 GJ |
| Total CO₂-e emission reduction | 43,225 tons |

EnMS Development and Implementation

In the past three years, we have established a complete energy management system and achieved significant energy-saving benefits.

Organizational

1. The Company has set up the leading team in the Management Level, headed by the vice president in

charge of energy conservation, who will be responsible for the overall supervision and promotion of the energy conservation and emission reduction.

2. The Company has set up the working team for energy conservation and consumption reduction, headed by the Technical Procurement Manager, who will be responsible for the implementation of the energy conservation and emission reduction. The energy management team of the Technical Procurement Department will assume the specific job responsibilities.

3. The departments have focal point persons for energy-saving (energy management system) to urge all entities (including the on-site shops and other entities) to run and implement the energy management system as required, ensure the target indicators are achieved and submit their energy analysis reports on time.

4. The departments' focal persons in charge of the contract management shall be responsible for the inspection and assessment of the operation and maintenance of various energy-consuming systems and ensure economical operation of energy-consuming equipment and effective implementation of the energy-saving measures.

5. The Company has also set up part-time energy management system auditors to participate in the review and auditing of the energy system.



Figure 2 Analysis meeting

Energy Review and Planning

1. The company conducts the energy review annually, including,

- the collection of laws and regulations and the compliance assessment (e.g. identification of the 4th national catalogue of outdated energy-consuming equipment in 2016);
- the energy-consuming system analysis and energy utilization overview (e.g., identification and review of the transformation projects in T2 in 2015);
- determination of major aspects/identification of energy-saving opportunities (new energy-saving projects is required to be proposed each year);
- developing the energy goals, indicators and management and implementation plans;
- developing the work plans and economical operation plans for the key systems;
- developing the energy performance monitoring and analysis plans.

2. Each year, the Company may break down the energy saving targets (not only the EnPI) of the Group to different departments and require such departments to break down the targets to different teams in a quantitative and qualitative manner.

3. Additionally the teams are required to develop corresponding key control points according to the actual situations. For example,

- the control point of the Comprehensive Office is to enhance the publicity of energy conservation and the objective is to conduct the publicity and supervise and inspect the energy conservation in offices on a quarterly basis;
- the control point of the baggage system is to shut down the sorters of the baggage system after the flights take off, and the objective is to achieve continuous reduction of energy consumption.

Cost Benefit Analysis

The cost over the past 3 years is more than 2,600,000 USD per year, including,

- The Company makes average annual investment of about 100,000 USD of administrative costs in system operation, energy-saving training and energy data system maintenance.

| No. | Project names | Annual cost (USD)/ year |
|--|---|-------------------------|
| 1 | Assessment of the energy management system | 7,700 |
| 2 | Special energy training | 7,700 |
| 3 | Maintenance and improvement of energy data system | 7,700 |
| 4 | Construction and improvement of T3 building energy management analysis system | 186,400 (in 2016) |
| 5 | Energy audit | 40,000/Once three years |
| Aggregate (on average annual investment) | | About 100,000 |

than 2,500,000 USD in the energy-saving projects (including the EMS projects).

| No. | Project names | Time | Efficiency Benefit Sharing (USD / year) |
|-------|---|------|---|
| 1 | LED renovation project(phase 1) in west area | 2014 | 77,000 |
| 2 | LED renovation project(phase 2) in west area | 2015 | 1,040,000 |
| 3 | LED renovation project(phase 3) in west area | 2016 | 930,000 |
| 4 | LED renovation project in parking structure of T2 | 2015 | 295,000 |
| 5 | LED renovation project of T3 passage | 2016 | 140,000 |
| 6 | GTC Photovoltaic Project | 2016 | 75,000 |
| Total | | | over 2,500,000 |

Based on energy performance contracting, annual shared saving has already exceeded 3,100,000 USD.

Approach used to determine whether energy performance improved

Since there is a correlation between airport energy consumption and passenger flow, we pay great attention to the intensity and set the following energy performance parameters.

- The overall energy consumption of the airport, compared with the unit throughput and energy consumption;
- The energy consumption of the terminal, compared with the energy consumption per unit area;
- Energy consumption of parking structure and compared with energy consumption per vehicle;
- The energy consumption of the airfield, compared with the energy consumption of the unit.

In addition, due to the heavier impacts of the weather, we not only compare the annual energy consumption, but also analyze the monthly year-on-year energy consumption.

Approach used to validate results

We have set up an energy data system to collect and analyze energy consumption data. We require various departments to make monthly analysis, for example, if more than 5% of the energy consumption over the past year is found, it is required to be analyzed and explained. For the LED replacement and other energy-saving projects, we have individual measurements and comparison.

Every year we make a review on the energy system and carry out the energy audit once three years.

“Through EnMS Development and Implementation, it is evident that there has been a significant improvement in awareness of and attention to energy at all levels of the company. The company has incorporated EnPI into KPI of each person, and engineers form an energy working group to analyze the energy consumption regularly. What’s more, front-line staff will include energy-saving into their own work.”

—Song Hui, Division Manager of Technological Service Purchase Dept.

Measures for maintaining the operational control effect

The major energy-consuming departments set up the economical operation plans for different systems, and ensure effective implementation of the operation specifications by means of records, random inspection and assessments; and continuously optimize the economical operation plans of the systems during the management.

The Company continuously implements the energy management system and ensures continuous improvement of the management system by means of energy assessment, in-system review, external review, energy-saving diagnosis, energy performance monitoring and management review as well as other measures. The operation management is the KEY to our

success. More examples will be mentioned in the 2.1 chapter.

Development and use of professional expertise, training, and communications

The Company organizes trainings for energy management staff on policies and regulations, systems, measurement and energy management.

The Company organizes energy-saving technical trainings for the front-line technicians on HVAC, power distribution and transformer, baggage, buildings and construction and other technical teams on a regular basis to improve their energy-saving awareness and professional ability.

During daily contract management, local management departments of the Company shall pay attention to the publicity and education of the front-line service staff of the contractual suppliers, and carry out the energy conservation assessment and bound in the cleaning, baggage, mechanical and electrical service contracts.



Figure 3 Popularizing the GPU to airlines

The Company arranges special funds for energy conservation publicity each year, and conducts various special publicity activities in the Energy Conservation Publicity Week. The Company also enhances the awareness of passengers on water and power saving by posters or broadcasting films.

In addition, the Company also participates in the energy-saving exchanges and studies with government (such as NDRC), the Group and other airports.

Tools & resources

The Company has developed the energy data management system, and may upgrade and improve the functions of the system on an annual basis according to the business needs and the feedback of all levels. The Company has established the energy analysis system in the terminals for energy efficiency analysis and assessment of the air conditioning systems on a regular basis. Additionally, the Company organizes the staff to solidify their experiences by means of QC team, management cases and science and technology projects and has them spread to the whole company.

The supports of external entities are also essential. The Company actively participates in the special energy-saving exchanges and trainings with Beijing Municipal Development and Reform Commission and the Civil Aviation Administration of China, and actively applies for the funds for energy conservation and emission reduction projects.

The Company works with CQC, SGS and Tsinghua University to carry out training, energy auditing and energy-saving diagnosis, develop various types of energy-saving planning documents, and actively conduct the pilot projects of electric vehicles, PV power generation and heat-pump air conditioning system for equipment room, which has been highly recognized by the superior authorities.

Lessons Learned

Experience

1. EnMS makes everyone pay more attention to the energy conservation.

Energy management cannot be accomplished by a few people in the department. It is necessary to

mobilize the enthusiasm of everyone.

BCIA paid more attention to the safety, operation and service, and its awareness of energy conservation was relatively weak in the past. For the majority of enterprise managers, compared with the promotion of energy conservation projects, the optimization of daily operation and management is complicated and fussy and requires a great deal of strength and efforts, but it is difficult to measure the benefits. Therefore, many managers are more willing to promote the energy conservation projects.

For example, security department has the mindset of “energy saving=lowering the service quality”, which makes it more difficult to promote the economical operation.

Therefore, the Company promotes the EnMS and the training of front-line staff, sets up the vice general manager-led special team for energy conservation with the Technical Procurement Department as the executive office and each department appointing responsible person to spread the EnMS to each staff and transfer the “passive energy-saving” behaviors to the “active energy-saving” behaviors.

2. Unlock the potential of operators.

The airport has the features of a large number of suppliers and management interfaces involved, complex exchanges and connections and difficult energy management. So, we need to unlock the potential of frontline staff.

For example, in the luggage transmission system, with the help of the system engineer, we improve the original program settings, so that the redundant parts can be suspended at night. The first step is to analyze the transmission data and study on the redundancy of

Through the Energy Management Working Group (EMWG), government officials worldwide share best practices and leverage their collective knowledge and experience to create high-impact national programs that accelerate the use of energy management systems in industry and commercial buildings. The EMWG was launched in 2010 by the Clean Energy Ministerial (CEM) and International Partnership for Energy Efficiency Cooperation (IPEEC).

For more information, please visit www.cleanenergyministerial.org/energymanagement.



baggage system. Then we develop special operation plans for the different belts, high-speed machines and the sorters, and develop the detailed operating procedures and timetables for the cooperation and joint operation between the central control staff and the operators. Finally, the T3 baggage system has achieved final power consumption reduction by 25% by defining the idea of stopping a part of systems in some special periods.



Figure 4. The luggage transmission system

3. Enhance the economical operation and management.

BCIA carefully defines its energy management conditions and benchmarks with external agencies, and develops targeted economical operation plans according to the characteristics of the systems. For example, the lighting system in T3 and the air-condition system in T1, which have already achieved satisfactory results by economic operations.

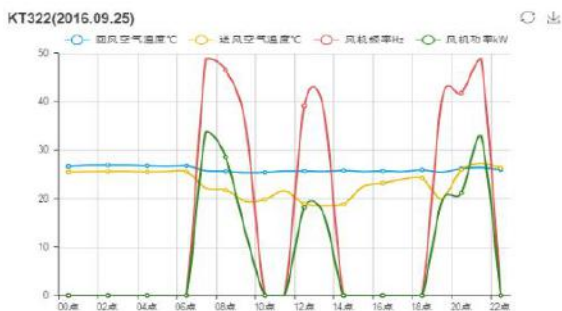


Figure 5 Data record and analysis

Through analysis and testing of the energy consumption and operation of air-condition system, T1 air-conditioning system has achieved energy-saving by 38% since its trial operation in T1 in the heating season of

2016 by developing reasonable economical operation plans to control the operating modes of units according to different seasons, time and environmental conditions.



Figure 6 T3 lighting system

In the case of energy saving schemes for T3 lighting system, we achieved the energy saving by 40% without LED replacement, which means about 9.5 million kWh annually. The key point is to refine the lighting areas (dividing 20 areas into 130 zones), and refine the lighting duration (adjusting 24 times a year from 3 times a year, lighting or shutting down gradually each time), and refine the resource allocation and refining the light source selection.

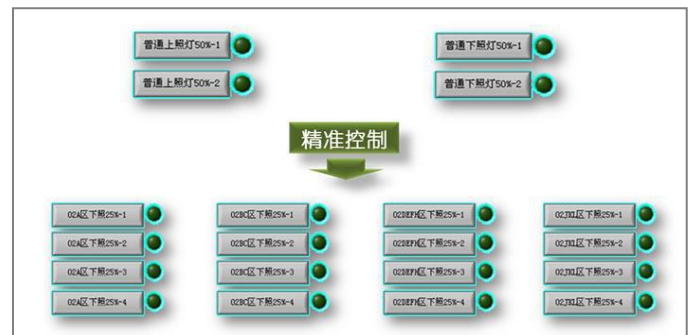


Figure 7 Precision controls in dispatch and various classifications

Keys to Success

- Leadership's commitment and full participation
- Good planning (identifying key energy equipment & facilities)
- Precise management (switch lighting time accurately to minute)
- Customization of the system (making it applicable to the airport/service industry)