ISO 50001 Energy Management System
Case Study

2020 CHINA

Hainan Airlines

Energy saving is not a slogan, but an action. Hainan Airlines took the lead in passing the external audit of the EnMS, becoming the first enterprise in the field of civil aviation transportation of China to obtain the third-party certification, opening up a "New Silk Road" for the green development of the civil aviation industry.

Hainan Airlines promotional graphics

Organization Profile & Business Case

Hainan Airlines Holding Co., Ltd. (hereafter referred to as "Hainan Airlines") was founded in January, 1993 in Hainan Province, the largest special economic zone in China. Since 1993, Hainan Airlines has achieved 27 years of safe operations equivalent to more than 7 million hours of safe flights. Hainan Airlines' fleet is composed mainly of Boeing 737s and 787s as well as Airbus 330s and 350s.

Since 2016, Hainan Airlines has cooperated with China Green Carbon Foundation for carrying out the "green way • carbon offset" public welfare project. The project calls on travelers to offset the CO2 generated by their flights with voluntary donations of cash or Jinpeng points, which will be used for mangrove planting and restoration at the Dongzhai port nature reserve in Hainan. Up to now, about 33.3 thousand square metres of mangrove has been planted and restored, providing a good living environment for plants and animals. Hainan Airlines hopes to increase passengers' awareness of energy conservation and environmental protection through this project, and advocates that passengers prefer green travel and support green aviation.

After completing the EnMS certification, Hainan Airlines has saved a total of 294,000 tons of fuel (12.86 million GJ), which is about 2.7% of total energy consumption, saving about 1.5 billion RMB (220 million U.S. dollars) in costs and reducing CO2 emissions by about 926,000 tons.

The cost of aviation oil is the largest cost of airline operation. As the fierce competition increases and energy resources becomes tighter, implementing the EnMS can reduce energy cost, which is particularly important to enhance the competitiveness of enterprises.

—Zhijun Zhou, the general manager of Operation control department

Case Study Snapshot	
Industry	communications and transportation
Product/Service	Passenger services
Location	Haikou , Hainan
EnMS	ISO 50001
Energy performance improvement period, in years	2014-2019(6 years)
Energy Performance Improvement (%) over improvement period	2.32%
Total energy cost savings over improvement period	$ 220 million
Cost to implement EnMS	$ 19 million
Total Energy Savings(GJ) over improvement period	12.86 million
Total CO_2-e emission reduction over improvement period	926,000 tons

Business Benefits

After completing the EnMS certification, Hainan Airlines regularly carries out EnMS audit every year for continuously improving the management level of energy conserva-tion; by the end of 2019, Hainan Airlines has maintained its EnMS certification for consecutive six years.

1.Achievements in improving energy performance

After establishing the EnMS, the average annual increase rate of energy performance reaches 2.32%.

Energy Performance Improvement (%):

$$\frac{\text{Base period unit consumption - Reporting period unit consumption}}{\text{Base period unit consumption}} \times 100\%$$

Unit consumption(tce/10,000 ton·km):

$$\frac{\text{Total energy consumption}}{\text{Transportation turnover Amount}}$$

Hainan airlines completed the construction of EnMS in 2014, the base period is 2013 and the reporting period is 2014-2019. The base period unit consumption is 4.2133 tec/10,000 ton·km; during the reporting period, unit consumption is 4.1156 tec/10,000 ton·km.

2. Energy cost saving and carbon emission reduction

Based on the EnMS, Hainan airlines has carried out nearly 30 measures in total. From 2014 to 2019, Hainan Airlines has saved a total of 294,000 tons of fuel (12.86 million GJ), which is about 2.7% of total energy consumption, saving about 1.5 billion RMB (220 million U.S. dollars) in costs and reducing CO2 emissions by about 926,000 tons.

3. Implementation cost of EnMS

After completing the EnMS certification, the cumulative cost of Hainan Airlines aviation's EnMS is about 134 million RMB(19 million U.S. dollars) from 2014 to 2019.

3.1 Labor time costs. At present, Hainan Airlines has about 10 full-time employees engaged in energy management, and the total labor time cost for 6 years is about 7.2 million RMB.

3.2 Third party energy audit cost. Hainan Airlines entrusts a third-party unit to audit EnMS every year, with a total cost of about 1 million RMB in the past six years.

3.3 Investment cost of technological transformation. Hainan Airlines has invested a total of 134 million RMB in technical renovation projects, such as New Split Scimitar Winglets, Aircraft oxygen conversion, light-weight dining car procurement etc.

3.4 System R&D and maintenance costs. In order to refine the analysis and statistics of fuel consumption in all stages of the aircraft, Hainan Airlines has developed the "HNA fuel monitoring system", which costs 6 million RMB in total in R & D and maintenance.

Plan

Through organizing training and publicity, energy review, compliance evaluation of laws and regulations, preparation, release and learning of manual documents and procedures, internal audit, management review and other steps, Hainan Airlines completed the certification of EnMS by the end of 2014.

1 Get top management support

The perfect EnMS will bring the company not only considerable energy performance, but also potential social performance.

As early as 2008, the company set a top-down energy conservation mode and carried out energy saving management with a management structure featuring company president-department in charge-permanent office- energy conservation project. In 2013, the president of the company started to prepare the EnMS construction team and served as the leader of the preparatory group. After a full study of the EnMS, the feasibility and advantages of establishing EnMS in airlines determined ; in 2014, the construction of EnMS was officially launched. Hence a new chapter was unfolded that Hainan Airlines embarked on the path of green development.

2. The energy use and analysis of aviation companies

The types of energy consumed by civil aviation companies include aviation fuel, water, and electricity. The consumption of aviation fuel is the main part of the entire energy consumption, and the consumption of water and electricity are mainly to meet the daily office needs of enterprises. Taking Hainan Airlines as an example, the aviation fuel consumption is 99.95%, and water and electricity accounts for 0.05% of the total energy consumption.

3.Combining energy use with corporate strategy

In order to promote the operation of the EnMS, Hainan Airlines regards ecological civilization and low-carbon economic construction as an important strategy to promote sustainable development of the enterprise.

3.1 The first stage goal: Hainan Airlines will use its own influence to increase passengers' awareness of energy saving, and advocate passengers to choose green travel.

3.2 The second stage goal: Promote the scientific-technical progress of enterprises, and apply advanced energy-saving technologies. Reach the domestic advanced level in terms of hardware devices production, by increasing and transforming the equipment condition to minimize fuel consumption in non-critical phase.

3.3 The third stage goal: Build a digital EnMS, to realize the automatic collection, analysis and statistics of all energy data, and to achieve fine management of Enterprise energy consumption.

4. Energy planning and implementation

Hainan Airlines conducts energy planning according to the steps of "analyzing energy use — identifying energy consumption influencing factors — assessing management and control status — exploring energy saving potentials — comparing energy saving measures — setting management and control targets — and issuing implementation programs". The selection of compareson measures followed the following principles:

4.1 Adapted to national energy-saving requirements and enterprise development planning, corresponding to the analysis of corporate energy-saving potential, while ensuring the realization of planning goals;

4.2 Fully evaluate the advanced level, feasibility, adaptability and economical efficiency of each project, and consider the impact on the environment after implementation;

4.3 Arrange the implementation plan of measures reasonably according to the enterprise development plan and capital status.

5. Multi sites development

EnMS certification sites are Hainan Airlines Base and HNA PLAZA. The production function departments are located in Hainan Airlines Base, including Flight Department, Operation Control Department, Maintenance Engineering Department, etc.; the non-production function departments are located in HNA PLAZA, such as Finance Department, Human Resources Department, etc.

The consumption of water and electricity are mainly to meet the daily office needs of Hainan Airlines Base and HNA PLAZA, the consumption of water and electricity, and the consumption of aviation fuel is the main part of the entire energy consumption.

The implementation of the EnMS can reflect corporate social responsibility, promote mutual understanding between the enterprise and society, enhance government and social recognition of the enterprise, increase the visibility and reputation of the enterprise, and establish a good social image.

—Shuo Gguo, the Chief dispatcher of Operation control department

Do, Check, Act

Hainan Airlines makes ”monitoring and warning report for energy saving” monthly, analyzes the data of various factors, reports the progress and KPI (key performance indicator) results. In the case of non-conformities or suggestions for rectification, asks all units to rectify and monitor improvements.

1. Energy saving measures

From 2014 to 2019, Hainan Air-lines has implemented nearly 30 energy saving measures, as follows:

1.1 Fleet Update

Eliminated a group old aircraft with high carbon emissions such as B737-300, B737-400, A340, introduced the world's most advanced B787 Dreamliner and constructed B737-700 / 800, B767, A330, B787 and other low-carbon aircraft team as well. For example, a large number of composite materials were used in the B787 to reduce the weight; B787 was equipped with the most advanced engine for optimizing the integration of the engine and the fuselage to minimize interference resistance. The introduction of B787 reduced CO2 emissions by 16% compared to similar models.

1.2 Technical innovations and retrofitting

1.2.1 New Split Scimitar Winglets

In October 2018, Hainan Airlines updated the new split scimitar winglets of Boeing 737 aircraft. Hainan Airlines

is the first domestic user of new split scimitar winglets of 737 aircraft. Update B737 fleets' blending wingtips to Split Scimitar Winglets, which can increase the average range of the aircraft by about 1500 kilometers and improve the aerodynamic performance of the aircraft at the same time. With this retrofit, fuel efficiency can increase 1.6%; an average of 114.7 tons of fuel was saved and 361 tons carbon emission was reduced by each plane per year.

1.2.2 Intelligent robots for aircraft surface cleaning

After a long flight, the outer surface of the aircraft will deposit dust, oil and other pollutants. These pollutants will further increase fuel consumption by reducing surface finish and increasing frictional resistance. To solve this problem, Hainan Airlines have developed, designed and manufactured intelligent robots for aircraft surface cleaning and processing independently, and obtained national utility model patents. The use of robotic cleaning aircraft can double the labor productivity, save more than 50% of water resources and reduce engineering costs by about 50%.

1.3 Operation Management

1.3.1 GPU replaces APU

APU is the abbreviation of aircraft auxiliary power unit, which is mainly used to supply power and air to the aircraft on the ground. Using ground power equipment (referred to as GPU, including ground power vehicle, bridge-mounted power supply) instead of on-board APU can reduce fuel consumption. GPU replacing APU is the key project of CAAC's "winning the defense of the blue sky". According to the principle of "full use of GPU", the company has refined and detailed the management and control methods through improving GPU management and control plans, carrying out localization management of GPUs at airports and other ways. Hainan Airlines won the Blue Sky Defense War and carried out far better results than other airlines, and won praise from the Central South Bureau. The project has saved 38,000 tons of fuel in 2019.

1.3.2 "CIRCLE FLY" project

This project makes full use of the characteristics of the prevailing westerly winds in the middle and high latitudes, and abandons the previous fixed pattern of westward headwind flights for New York and Boston return flights. It can realize that the flights return to the east and round the earth.

Compared with the previous routes, although the "CIRCLE FLY" route has increased flight distance, the impact of high-altitude downwind will reduce the average flight time of North American routes by more than 30 minutes, while reducing operating costs and carbon emissions, and improving passenger comfort for long-haul flights as well. According to estimates, just for the two routes of Chengdu / Chongqing = New York, implementing the project is expected to save about 12 million RMB(1.7 million U.S. dollar) in operating costs and reduce 2,200 tons of CO_2 emissions per year.

In addition, Hainan Airlines also implements air distance optimization, planned payload optimization, aircraft center of gravity optimization control, single-engine slip-in, wide-body idle speed, aircraft weight control etc.

1.4 Bio jet fuel

Hainan Airlines took the lead in using domestic biological aviation coal to complete the first domestic commercial passenger flight and the first international trans-ocean commercial passenger flight on March 21, 2015 and November 21, 2017 respectively. As a typical clean energy, compared with traditional aviation kerosene, bio-jet fuel can reduce carbon emissions by more than 50% in the whole life cycle. It can also realize the recycling of resources with obvious overall benefits. The success of the commercial demonstration flights has not only verified the safety and reliability of domestic biological aviation coal, which can meet the quality and safety requirements of civil aviation transportation, but also covers the entire process of bio-fuel production and transportation to get a lot of replicable and polarizable experience. It's good for promoting the clean energy transformation of China's civil aviation industry.

2. Establish an inter-departmental leadership team

The various departments within the airline can be divided into production departments and non-production departments. In order to achieve unified leadership and clear division of labor for project management, Hainan Airlines has established an inter-departmental aviation fuel management project leadership group, which is led by the company's leaders,

coordinated by the leaders of each branch company and directly participated by the general manager of each department. The leadership team establishes the ledger of each program, holds regular aviation fuel cost meetings and weekly reports aviation fuel management results. Therefore, the problems that exist in the project promotion process would be solved.

3. Monitoring and evaluation system

In order to ensure implementation of energy-saving projects, the HNA Standing Office of Energy Conservation and Emission Reduction requires each project responsibility unit to provide monthly feedback on the completion of the project's monthly goals, progress, problems and improvement. At the same time, according to the feedback, the Office prepares a monthly report of "Monitoring and Early Warning" to inform the company of the completion of each project, gives notice of the incompleteness and urges all units to make corrections.

Regarding the evaluation of energy-saving projects, the Office mainly scores from three aspects: the completion of the project process indicator (KPI), the completion of the project's fuel-saving amount and the project data management. In addition, the overall scores of each unit are ranked publicly monthly.

4. Implementation of the EnMS

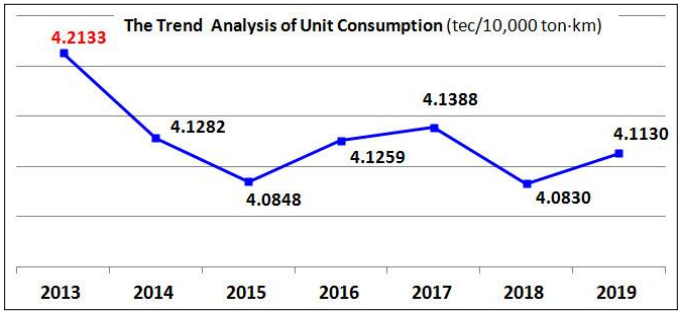
4.1 Completion of energy targets

After the establishment of the EnMS, Hainan Airlines has completed the energy index every year. From 2014 to 2019, it has saved 294,000 tons of aviation oil, 110% of the total energy saving target. In 2019, the energy saving target is 82,500 tons of aviation oil, and the actual energy saving is 94,000 tons.

4.2 Energy performance improvement

The unit energy consumption that is customary in the domestic civil aviation industry is "fuel consumption per ton · km.", which is affected by many factors, such as load factor, route wind, aircraft weight, flight altitude, performance attenuation, flight distance, center of gravity position, fleet update etc.. And the load factor, significantly affected by factors such as seasons and markets, is uncontrollable.

In order to improve the energy performance, Hainan Airlines carried out all-round energy conservation work from the aspects of fleet renewal, center of gravity position, deep weight reduction, flight altitude, ground energy conservation, and implemented nearly 30 energy saving measures(see" Energy saving measures"). From 2013-2019, the unit energy consumption of Hainan Airlines is as follows:



The unit consumption in 2019 is lower than that in 2018, mainly due to the difference of 2.9 percentage points in the load rate. After eliminating the impact of the load rate, the unit consumption in 2019 is 3.9937 tec/10,000 ton·km. Compared with the base period(in 2013), Hainan Airlines' energy performance in the reporting period(from 2014 to 2019) increased by 2.32%.

4.3 Use tools and resources

QAR (quick access recorder) completely records all kinds of important data (including aircraft weight, altitude, speed, position, fuel consumption and other data) in the whole flight process. In order to accurately analyze the use of aviation fuel at each stage, Hainan Airlines started with the analysis of QAR data, tapped the value of QAR data, developed the "HNA Fuel Monitoring System", and introduced a three-level indicator monitoring system such as ton-kilometer fuel consumption, revised ton-kilometer fuel consumption, corrected hourly fuel consumption, landing residual fuel, and performance degradation, and effective exploration in improving d work efficiency.

Transparency

Based on the fast information dissemination and convenient retrieval of network media, in 2015, Hainan Airlines publicly announced the ISO 50001 certification of EnMS in the form of press release (name of press release: Hainan Airlines, the first civil aviation company in China to obtain an EnMS certification). And the press

release was reposted by many medias, such as China Aviation News, China Daily, etc.

Hainan Airlines, as the first civil aviation company in China to obtain an EnMS certification, is constantly exploring the road to sustainable development. In 2014, co-editing the "EnMS Transportation Enterprise Certification Requirements" and based on Hainan Aviation 's EnMS, Hainan Airlines established a set of energy management models that can be promoted and replicated to provide a reference for other domestic airlines' energy management. In order to promote the construction of green aviation in China, Hainan Airlines, relying on the EnMS, in June 2016, led the United Technologies Company, Global Contract Network, Boeing, Airbus and other 18 units to launch "Green Aviation Initiative Network"(GAIN), making a collection of each link of the aviation industry chain and building a new model on global green aviation. In November of that year, the first domestic "Green Aviation White Paper", including the ISO 50001 certification of EnMS of Hainan Airlines, was jointly issued to provide green and innovative solutions of the global civil aviation industry.

Lessons Learned

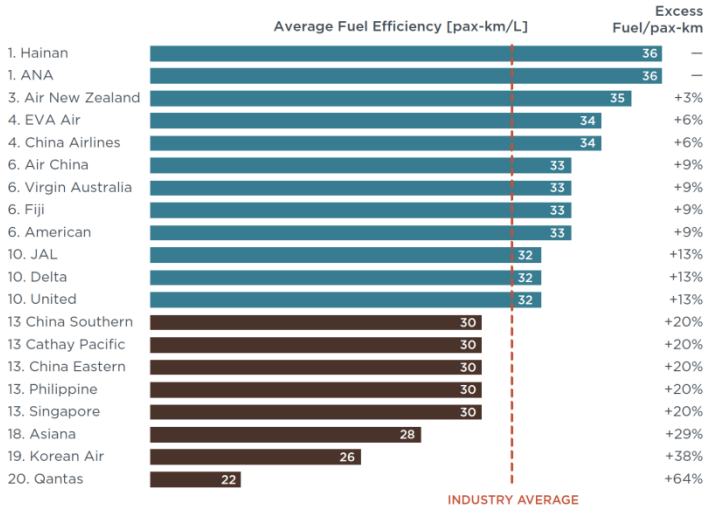
"Green operation and low-carbon flight", Hainan Airlines has become a pioneer in the green field of civil aviation of China by virtue of its EnMS. However, if EnMS is carried out again, the following measures would be taken in advance:

1. Establish an inter-departmental leadership team to solve the problem of mutual promotion among departments.

2. Establish a new assessment and incentive system. Transform the traditional results-based incentive model to a project-oriented method, incorporating fuel-saving activities in positions other than pilots into the assessment management control. In addition to high material rewards, employees who are active in saving fuel are given certain spiritual honors.

Quotes and Visuals

Energy management starts from the heart, and low carbon leads to practice. The EnMS promotes Hainan Airlines to rank first among all trans Pacific Airlines in terms of energy efficiency (issued by the ICCT in 2018).



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.

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