

ISO 50001 Energy Management System Case Study

China

Yumen OilField company of CNPC

Yumen oilfield company is the first oil field certificate ISO 50001 in CNPC.



Yumen Oilfield Production Command Center.

Organization Profile & Business Case

Company profile: Yumen oilfield was developed and constructed in 1939. it was built as first natural petroleum base in China .In 2018,Yumen oilfield has extracted 410 thousand tons of crude oil and processing 2.1 million tons of crude oil with total output value of ¥ 12.7 billion. Its total energy consumption is 516 thousand tons of standard coal, and total energy consumption of Industrial output value is 0.36 tons standard coal, decreased by 4.8% and 26.3% compared 2015.The task "double control" of government energy consumption has been achieved.

“As a energy production company, we should reduce the energy consumption ,Only in this way can we develop sustainably.”

—Chen Jianjun,general manager of yumen oilfield

Case Study Snapshot

| | |
|---|---|
| Industry | Petroleum and natural Gas Exploitation |
| Product/Service | crude oil, petroleum product, electricity, heating power; machinery equipment |
| Location | Jiuquan, China |
| Energy management system | ISO 50001 |
| Energy performance improvement period | 3Years |
| Energy Performance Improvement (%) over improvement period | 7.42% |
| Total energy cost savings over improvement period | US \$ 6.854 million |
| Cost to implement EnMS | US \$ 1.35 million |
| Total Energy Savings over improvement period | 731750 (GJ) |
| Total CO2-e emission reduction over improvement period | 62500(Metric tons) |

EnMS Drivers: Yumen oilfield regards the construction of energy management system as an important starting point and breakthrough for enterprises to increase revenue, reduce expenditure, reduce costs and increase efficiency. By strengthening energy control and management, paying close attention to the implementation of responsibilities, adjusting and optimizing the structure, and implementing potential improvement, it has promoted the green, low-carbon and high-quality steady development of enterprises.

The function of Energy Management in Corporate Strategy : By implementation of the energy management system, it effectively improves the

efficiency of energy use and reduces the cost of energy consumption, which Provide effective help for .

- The first batch of "water-saving enterprises" in 2017 named by Gansu province.

Business Benefits

Since 2016, Yumen Oilfield actively introduces the concept of "planning, implementation, inspection and improvement" (PDCA) cycle management ,and integratedly apply Innovative management means ,such as statistical monitoring, energy efficiency benchmarking, energy consumption quota, energy conservation review, energy audit, energy management and Control. It has made remarkable achievements in promoting the construction of energy management system.

Direct benefits:

- Energy performance increased by 7.42% in 2016-2018.
- Achieve the target to conserve energy of 25000 tons of standard coal in 2016-2018.
- Achieve the target to conserve 271,000 cubic meters of water in 2016-2018.
- Eliminate 62500 tons of greenhouse gases.
- Save the cost of energy 6.854 million US Dollars.

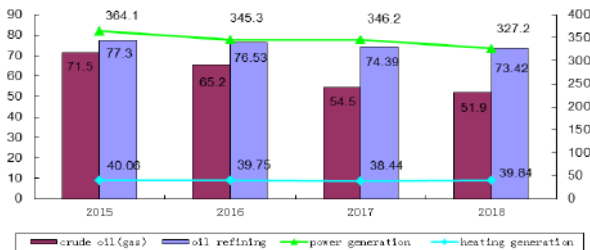


FIG. 1. The improvement of unit product energy consumption.

Indirect benefits:

- Improve the management of energy saving and consumption reduction.
- Form a mechanism with a variety of management means ,and improve the overall effect and efficiency of energy conservation work.
- Establish an energy management Model of full chain that contain oil and gas exploitation - gathering and transportation - processing – refining.
- Enhance staff's awareness of energy conservation and create a new image of the company.
- CNPC has been awarded "Advanced Energy-saving and Water-saving Enterprise" for 7 consecutive years.

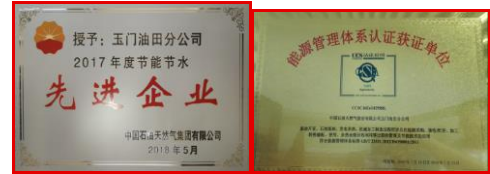


FIG. 2. Awards and certification plaques

Cost of EnMS implementation: In the past three years, Yumen oil field invested \$900,000 to carry out the research on optimization technology of refining and energy system for development and construction of energy management platform of Jiudong oil production plant. Invest \$75 ,000 annually to guarantee monitoring rate of main energy equipment to be over 20%. Invest \$15,000 in carrying out audit of energy management system. Establish a special bonus for energy conservation of \$30,000 and organize advanced evaluation activities of energy saving and water saving. Use the funds of \$30,000 for outward training or internal communication training to promote staff's business and operation level.

Advantages of multi-site management: Yumen Oilfield is a comprehensive petroleum company with oil recovery, oil refining, power and heating generation, mechanical processing and other sites. Because each site has different application of energy and different objectives of management , it is necessary for each site to implement different measures according to its own energy performance and efficiency industry standards, so as to make energy management targeted and effective.

Plan

Every five years Yumen oilfield makes plan for overall deployment of energy saving and water saving . At the beginning of each year, We formulate the energy-saving and water-saving work plan for this year. In order to provide guidance for energy managers at various production sites.

Leadership organizational structure: To gain the support of top managers and access to the necessary human, material and financial resources, Yumen Oilfield has set up a leading group of energy management

headed by the general manager for coordinating departments to fulfill their management responsibilities, and ensuring that all resources can be fully mobilized and utilized. All energy-saving management measures can be effectively implemented.

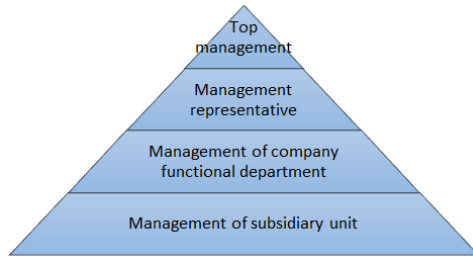


FIG. 3. Organizational structure of energy management

Establish a three-level management network: Planning Office is the energy management department of Yumen oilfield. It has set up energy management posts for secondary unit equipped with full-time energy management personnel, and established a three-level management network of "factory office-team station-team". The number of netizens reached 145.

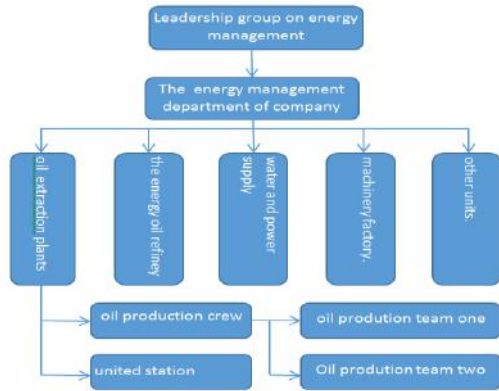


FIG. 4. Three-level management network structure diagram

Data utilization: Yumen Oil field has formulated a three-level energy performance parameter system that is "plant-workshop-equipment" and specifies the frequency and mode of acquisition and the method of data calculation and processing. of each performance parameter in detail. We aggregate and analyze the data every month to determine whether energy consumption is reasonable and whether more adjustments are needed.

Target setting and decomposition: According to self-development plan, Yumen Oilfield will divide the target among each production site in the annual work plan of energy-saving and water-saving. The energy-saving

managers of each production site will formulate the corresponding energy management implementation plan in the light of the target value.

Carry out Energy Assessment: Yumen Oilfield holds energy evaluation in February every year. (Energy assessment will also be hold when significant changes occur in energy facilities, equipment and energy structure.) and formulate "Technical Specification for Energy Assessment". (It is an company standard. At present, there is no similar standard in China that can guide company to carry out energy evaluation in detail.) The meeting guide all units to carry out energy assessment.

By energy balance analysis, and energy audit, Yumen oilfield identifies major energy application and finds out if there are opportunities for optimization and improvement, and prioritizes the identified opportunities for improvement, and prioritizes the identified opportunities for improvement. Then make improvement methods one by one and optimize and improve them. If these improvements require funds for technical improvement, the manager representative will report to the general manager for financial support.



FIG. 5. Energy review site

Application of EnMS in Multi-field Points: EnMS of Yumen Oilfield includes oil extraction, oil refining, electric power generation and heating, mechanical processing and other sites. Each site has a clear boundary of EnMS, and there is a full-time energy-saving manager holding responsible for the operation. It makes the EnMS of each site not only operate independently at the site, but also integrate with other sites. Sites are led by energy-saving management departments and supported by manpower, finance and other resources.

“EnMS provides the possibility to promote the high-quality development of company”

—Fan Mingtao Representative of Yumen Oilfield Manager

Do, Check, Act

Operation of EnMS: There are 18 authorities and directly departments and 21 basic units under Yumen Oilfield. Every department and basic unit has full-time energy managers, who are managed by the company's energy management department. As mentioned above, EnMS of Yumen Oilfield has covered all staff and elements. Everyone is a participant in energy conservation management, from the general manager as the top manager, to the energy management department, to the basic units and workshop teams. It enables EnMS to be effectively implemented in the company.

Responsibility of achieving objectives: At the beginning of each year, Yumen Oilfield will sign the annual energy-saving target responsibility agreement with the leaders of each production site ,to determine the target and quota of energy saving. It is included in the performance examination at the end of the year .The main targets and quota include total energy consumption, energy saving, water saving, and important production unit consumption indicators and energy efficiency indicators of major energy equipment.

Motivation and support: Top managers of Yumen Oilfield personally participate in major decision and deployment of energy management and provide effective resources for it, including providing adequate staffing, setting up special funds for general managers, providing incentives for outstanding energy management units and individuals, and approving large amounts of funds for energy-saving technological company. Since 2010, we invest \$30 million in technology renovation to improve the energy performance.

Some energy-saving projects since 2010

| Time | project | investment | saving/ year |
|------|---|------------|--------------|
| 2010 | Energy-saving renovation project of heating system | \$567.34 | \$186.03 |
| | Application of Energy-saving Technology in Solar Energy Lighting | \$134.37 | \$24.19 |
| 2011 | Comprehensive energy-saving transformation for improving the efficiency of thermal system in Hydroelectric power plant. | \$895.80 | \$217.23 |
| 2012 | Low-efficiency and high-consumption equipment updating | \$268.74 | \$59.72 |
| 2013 | Comprehensive Energy Saving Reform of Qingxi Ground System | \$268.74 | \$68.68 |

| | | | |
|------|--|----------|---------|
| 2014 | Energy-saving renovation of heat system and waste heat recovery and utilization of sewage in Laojunmiao United Station | \$388.18 | \$86.59 |
| 2015 | Energy-saving renovation of water injection wells in old areas | \$177.67 | \$61.21 |
| | Application of Energy-saving Technology of Compound Permanent Magnet Motor Pumping Unit | \$186.63 | \$22.10 |
| 2016 | Electric motor energy efficiency improvement and energy saving renovation project. | \$194.09 | \$48.07 |

Training and publicity: The company organizes energy-saving management training courses every year. Over 200 elites are trained in three years. After receiving training from higher-level, these elites will organize other employees to carry out training .By this way, the scope of staff training can cover the entire operation level ,witch has greatly improved work efficiency and business level.

In addition, along with participating in national energy-saving publicity activities such as Energy-saving Publicity Week and Low Carbon Day, the employees' awareness of energy-saving and initiative of energy-saving have been effectively improved.



FIG. 6. Discussion on EnMS construction

Energy efficiency benchmarking: In the energy efficiency benchmarking unit of petroleum energy-saving and water-saving management system ,and organize oil production plants to formulate energy efficiency benchmarking scheme, carry out benchmarking analysis, annual evaluation and release energy efficiency benchmarking in half a year. Establish benchmarking group with CNPC reservoir oilfields, Learn from each other's benchmarking experience and exchange best energy-saving practices; In refining, the energy consumption of refinery, single factor energy consumption and comprehensive loss rate are used as indicators to compare benchmarking with similar refineries of CNPC, so as to continuously tap the potential of material balance, reduce energy

consumption and control cost. In order to improve the efficiency of energy conversion.



FIG. 7. Energy-saving and water-saving management system

Energy-saving monitoring: In addition to completing sampling and general survey by superior energy-saving monitoring agencies, Yumen Oilfield also organizes monitoring and testing of key energy-using equipment or systems of key energy-using units by itself, which is tested every five years. Of course, some of the most important equipment, such as pumping units, heating furnaces and other major energy-consuming equipment, will be tested every year to determine whether the performance of the equipment is in the best state, and to guide the units to optimize the operation of the equipment on the worksite.



FIG. 8. It is mainly monitored by energy equipment

Energy management and control: In 2017, Yumen Oilfield invested \$450,000 to carry out pilot construction of energy management and control system in Jiudong Oil Production Plant. The crude oil production, water injection and energy consumption are tested by installing an automatic monitoring instrument with remote transmission function. The energy management and control software system has been developed and constructed. The system can collect all kinds of production and energy consumption data through automatic instruments. After calculation and analysis, it can display the operation efficiency of various equipment in time. It also provides alarm and

optimization scheme for energy-using equipment or energy-using behavior that deviates from normal range, and promptly reminds operators to find out the cause of the problem and optimize the operation of the equipment.

Determining energy performance improvement: We base our energy intensity on 2015. The energy improvement of each site is determined by the change of total energy consumption during the reporting period. Then according to the proportion of energy intensity in each place, the total energy improvement of the company is calculated by weighting. The total energy intensity is calculated by total energy consumption, total products or output value. Energy improvements at seven sites are shown in figure 1 (four oil production plants are represented as a whole due to the same business). In determining the calculation of energy improvement, we will first exclude the following major factors that cause changes in energy consumption:

- Variation of heating days caused by weather change.
- Variation of energy consumption caused by the upgrading of oil quality.
- Variation of energy consumption caused by change of the number of oil wells .
- Variation of energy consumption caused by change of the properties of processed crude oil.
- Variation of output value caused by changes in market prices.

Approach used to validate results: Yumen Oilfield has established an energy data system to collect and analyze energy consumption data. Each unit is required to carry out energy consumption statistical analysis every quarter to calculate the unit consumption indicators such as crude oil (gas) production comprehensive energy consumption, refinery processing comprehensive energy consumption, power generation standard coal consumption and so on. If it is found that the energy consumption changes by 5% , it needs to be analyzed and explained. At the same time, we invite national qualified energy assessors and auditors to carry out energy audits every three years. In addition, in the ISO50001 audit, third-party organizations will also verify the improvement of the

main unit consumption indicators to ensure the effectiveness of the system operation.

Tools and resources:

In order to effectively improve the level of energy management, Yumen Oilfield has developed and introduced some effective tools and resources.

- The energy management and control system of Jiudong Oil Production Plant has been developed, which realizes automatic data acquisition, automatic calculation and automatic operation optimization and adjustment suggestions.
- Establishing energy-saving and water-saving management system, realizing the sharing of energy consumption data, energy-saving projects, index assessment, energy-saving monitoring, advanced technology and equipment;
- Establish a monitoring database of energy consumption of pumping unit system, effectively analyze the operation of pumping unit.
- Carry out energy performance contracting.

Operational control: Yumen Oilfield has formulated detailed operation rules and control procedures, which are distributed to every post. In some important operation positions, process cards are also formulated. Operators are required to operate strictly according to the process parameters on the cards. In some important operation positions, process cards are also made to require operators to operate strictly according to the process parameters on the cards. Strictly enforce the maintenance system.

Operators will inspect the equipment hourly or every few days according to the importance of the equipment, and check whether the equipment is running normally, or whether it has reached the

maintenance period, and make detailed records.

Whether the supervising staff of Yumen oilfield operation Department and equipment management department do well in operation and equipment maintenance.

Transparency

Yumen Oilfield was certified by the third party ISO50001 in July 2016. After obtaining the certification, it was reported to CNPC. Since Yumen oil field is the first oil field independent company to pass ISO50001 certification, in July 2017, there are 16 oil and gas field company of CNPC coming to Yumen Oilfield to learn and exchange EnMS management and certification experience.

In addition, Yumen Oilfield will also report the certification information to the Gansu Development and Reform Commission and the Gansu Energy Conservation Supervision Center, which is affirmed by them.

Lessons Learned

The success of EnMS in Yumen Oilfield depends mainly on the direct leadership of the top managers, the establishment of a consummate three-level management network and the establishment of a consummate management system to ensure the effective implementation of energy management initiatives, but there are still many areas to be improved .such as : Measuring instruments of Energy is imperfect ; Energy conservation awareness of employee should be enhanced.

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.

