

The Design of Flat Energy Management Structure for Iron & Steel Enterprises in China

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Abstract

Under the background of large scale adoption of BATs (Best Action Technologies) and limited technical energy saving space, the management innovation of iron and steel enterprises is a significant direction of development for energy saving and emission reduction. At present, many iron & steel enterprises in China have established energy centers with EMS to realize more informationized and efficient energy management. However, the energy saving effects differ among different enterprises, some of which haven't achieved prominent effects through energy management. In this investigation, It has been found out that the most curial reason for low management efficiency is that the hierarchical management structure has largely restrained it. Current energy management mode of iron & steel enterprises in China can hardly meet the needs of informationized management. The energy management structure needs to be reconstructed toward a flat structure. Various flat energy management structures for iron and steel enterprises in China are designed and analyzed aiming to be references.

keywords: iron and steel; energy management; flat structure.

1. Introduction

Iron and steel industry is the world's most typical high energy consumption and GHG emissions industry ^[1]. For China, iron and steel industry is the third biggest GHG contributor in 2014 ^[2]. Energy saving is quite a significant issue for iron and steel enterprises in China.

Actually, the energy saving BATs (Best Action Technologies) ^[3] for iron and steel industry have been applied on a large scale among influential enterprises in China ^[4], which means limited space for technical improvement. The energy management innovation of iron & steel enterprises is a significant direction of development for energy saving and emission reduction ^[5].

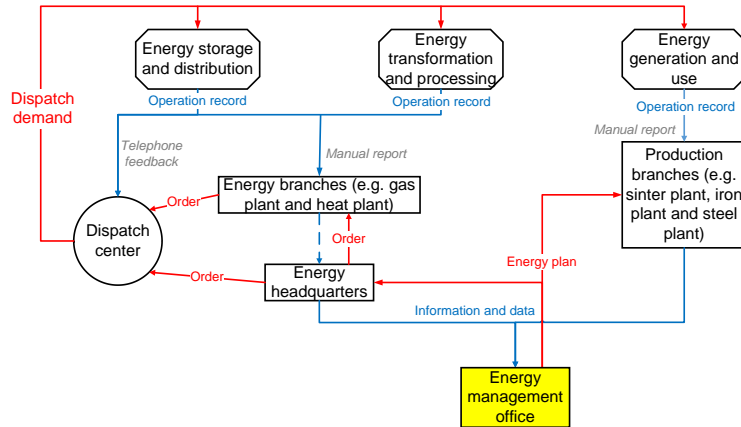


Fig.1. Traditional energy management workflow in iron and steel enterprises in China

As shown in Fig.1, traditional energy management workflow is inefficient without any doubt. It is the hierarchical management structure and low information transfer efficiency that lead to awful management effect.

Now many iron and steel enterprises in China have established energy control centers or energy centers with EMS (Energy Management System) to realize more informationized energy management. However, the energy saving effects of EMS differ among different enterprises. As information transfer efficiency has been greatly improved through EMS, attention should be paid to the energy management structure. How to combine energy management with EMS is the key to make a difference, which means that a redesigning of energy management structure is necessary. That's why this investigation is so important. The paper is organized as follows: After proposing the research background and objectives in introduction, the second section analyzes functions of EMS in iron & steel enterprise and the core status of energy center in energy management. The third section analyzes the necessity of transition to flat energy management structure for iron & steel enterprise. In section four, we design various improved energy management structures. In the final section the conclusions are derived.

2. The EMS and energy management of iron and steel enterprises in China

2.1. The EMS in iron and steel enterprises

EMS is an information platform to collect all important information, including energy generation, use, storage, distribution, transformation and processing information from each plant or equipment. All these valuable information will support the energy management at all levels, as shown in Fig.2.

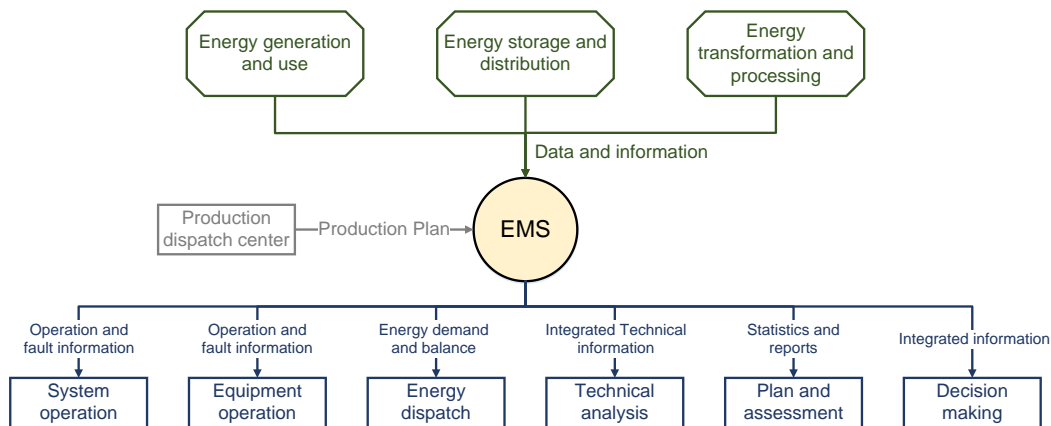


Fig.2. Information and application of EMS in iron and steel enterprises

The information flow analysis will opportunely support energy dispatch with energy demand and balance information to reduce energy dissipation. More data and integrated information can be used for technical analysis, plan and assessment to achieve a more reasonable production, not to mention the important decisions. For specific advanced enterprises, EMS can be transformed into an operation platform for fast and timely operation.

2.2. Energy management with EMS in iron and steel enterprises

Through the analysis above, energy dispatch is a timeliness work to balance energy demand and supply with wide influence, which makes energy dispatch the key to energy saving. However, energy dispatch is not an isolated work. All relevant elements will support it to guarantee the timeliness and accuracy. All kinds of energy with high interchangeability in an iron and steel enterprises can make energy dispatch a quite complicated work. The energy balance keeps complex dynamics due to the interaction among different kinds of energy. The whole production process will be significantly affected just when a single production unit is abnormal. So right energy dispatch decisions should be made in a timely manner to keep the whole production process safe and economical. The efficient information delivery is absolutely necessary with all important support and cooperation.

Energy management with EMS is as shown in Fig.3. Energy dispatch by energy center becomes the core of energy management in modern iron and steel enterprises. EMS supports it with all valuable information to achieve the least waste of energy and this is why EMS helps energy saving. This is one of the most important result based on our investigation.

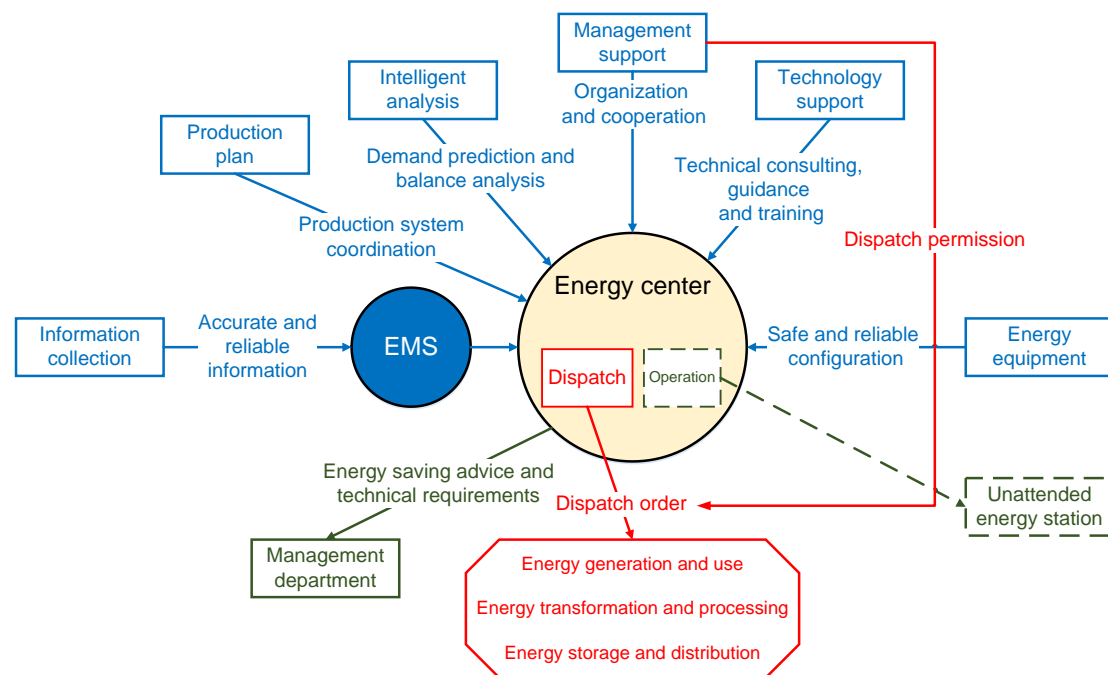


Fig.3. The supporting elements of energy dispatch by energy center

The supporting elements are much more than EMS, which provides accurate and reliable information. Production plan can greatly affect energy supply and demand. Through intelligent analysis, the energy balance prediction can be the notice for energy dispatch. The technology support guarantees the safety and rationality with all well-configured energy equipment. Energy management should work with other issues under management support. Nevertheless, it is no doubt that how energy dispatch by energy center works is the decisive factor of energy management in iron and steel enterprises.

3. The necessity of energy management structure reconstruction

One thing we should pay attention to now in Fig.3 is the red elements about dispatch. It is the dispatch permission that determines whether the dispatch order can be executed. However, the dispatchers are usually low-level in iron and steel enterprises with hierarchical management structure, which means the dispatchers always have to apply for dispatch permission from superior management department level by level. As a result, missing the best dispatch time is prone to happen when dispatch order delays and poor dispatch effect is expected.

So the energy management structure has restricted the energy management efficiency, especially when EMS has made information transfer efficiency much improved. Hierarchical management structure need reconstruction.

To make energy center do better energy dispatch work, every supporting element is equal, no matter technology support or management support. All valuable information can be equally obtained from EMS and the safety or rationality of energy dispatch can be guaranteed. It is more important to make energy dispatch efficient with quick response and decision-making. That's why hierarchical management structure is not needed any more. Though flat management structure is quite new for iron and steel enterprises in China, there are many successful examples all over the world that have made management more efficient, especially in IT enterprises. It seems just the right combination of information technologies and flat management structure [6]. When iron and steel enterprises in China are moving forward to informationized energy management, the management structure dose need transformation into flat management structure. In fact, the management structure transformation is a long way to go. But it is quite necessary to improve the energy dispatch process at first.

4. The design of flat energy management structure

Integrated energy management by modern energy center of China first appeared in Baosteel in 1980s. As energy center has been widely promoted, so many iron and steel enterprises in China such as Tianjin Iron & Steel Group Co., Ltd., Hunan Valin Xiangtan Iron and Steel Co., Ltd., WISCO, Benxi Steel Group Corporation and Shougang Group. Informationized Energy center with EMS has been also promoted by government, which means demonstration projects will receive financial subsidies. But based on our investigation, few enterprises realized the necessity of energy management structure reconstruction as most regarded energy center as a technical project. The large-scale investments have not necessarily improved the energy saving effect in many enterprises. Some have tried to adjust the energy management structure, these work is still lack of theoretical guidance.

Here we try to provide some improved, or flat in a more accurate saying, energy management structures which are divided into two levels by different flatness. All the patterns of energy management structure are abstract summaries based on typical iron and steel enterprises in China.

4.1. Total flat structure

Total flat structure as shown in Fig.4 means an energy management structure with only two levels. Department of energy located on the first level owns the highest permission for energy management. Other branches are all located on the second level, energy dispatch operation included. The typical, or only, example in China with total flat structure is Baosteel headquarters, which may explain its excellent energy performance.

Some outstanding features make total flat structure efficient. All important operations are unattended and remote. Department of energy is directly in charge of energy dispatch operation and no dispatch order

delay will happen. All supporting elements of energy dispatch can be organized well by department of energy to realize quick dispatch response. It is no doubt that total flat structure is the best structure for informationized energy management with high efficiency.

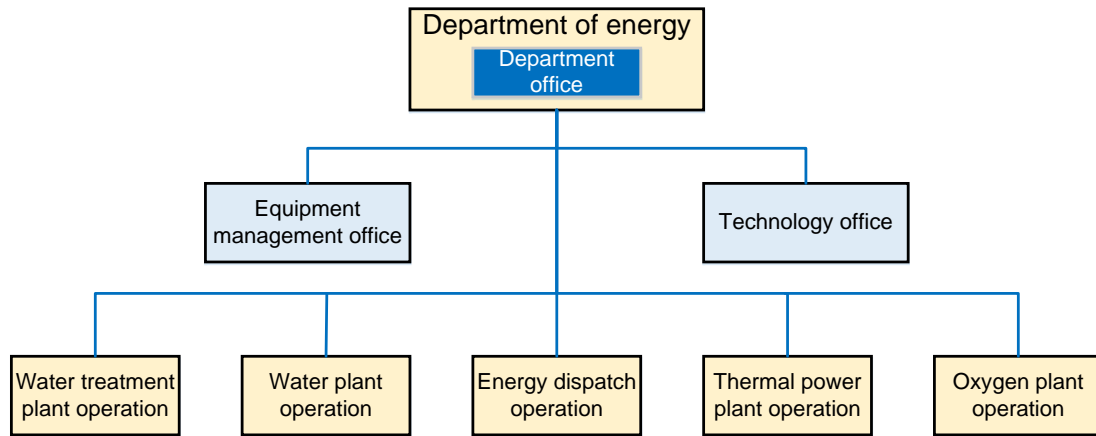


Fig.4. Schematic diagram of total flat structure (based on Baosteel)

4.2. Partial flat structure

Partial flat structure here means structure with more than two levels and all operations are at the bottom level. For some enterprises, top energy management department is directly in charge of energy dispatch for higher dispatch permission. Even when energy dispatch is located in the second level and some commissioners from top energy management department are needed to support energy dispatch, we still regard it as a kind of partial flat structure with lower flatness. Energy dispatch permission is just guaranteed under partial flat structure, which is the key issue of energy management. As a result, every supporting element of energy dispatch is still organized in a not quite efficient way.

The most ideal partial flat structure is shown in Fig.5. The main differences between total and partial flat structure is about the unattended and remote operation. Reasons that not using unattended and remote operation for enterprises are usually including equipment reliability, information technologies and layoffs difficulty.

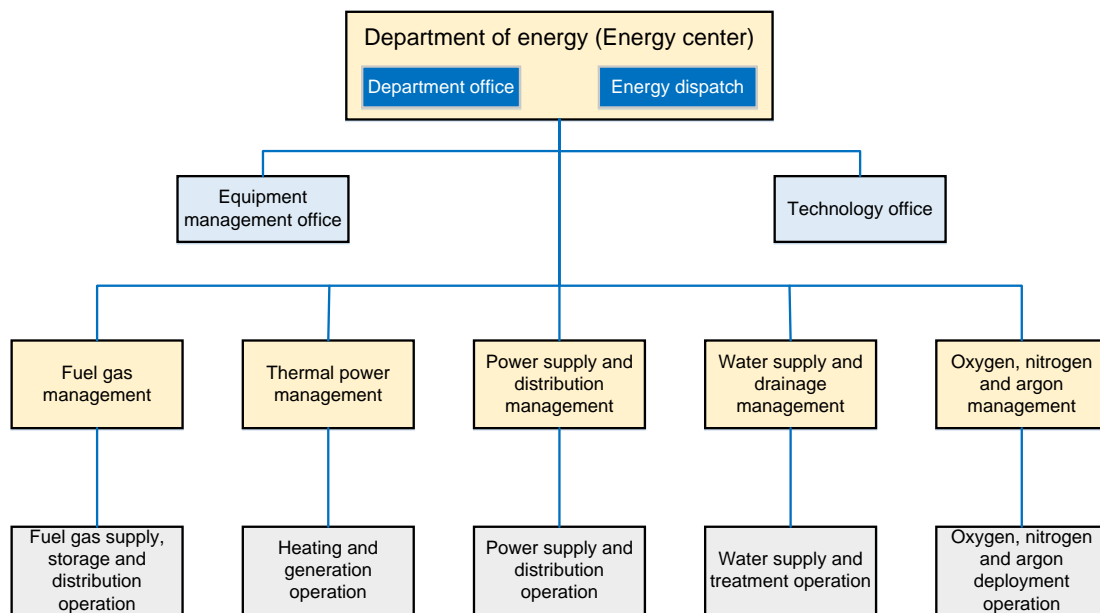


Fig.5. Schematic diagram of typical partial flat structure

4.3. Case model analysis of partial flat structure

Different iron and steel enterprises in China have made their own energy management structure with different features. Here we choose three typical case model and sum up their features. A comparison will reveal the gap of energy management between enterprises.

Case model 1 is based on Tianjin Iron & Steel Group Co., Ltd., as shown in Fig.6. It's absolutely a typical partial flat structure like Fig.5 with good energy saving effect. But structure redundancy of energy center makes it hard to manage for energy center. The improvement for Case model 1 should be unattended and remote operation to make it transform into total flat structure.

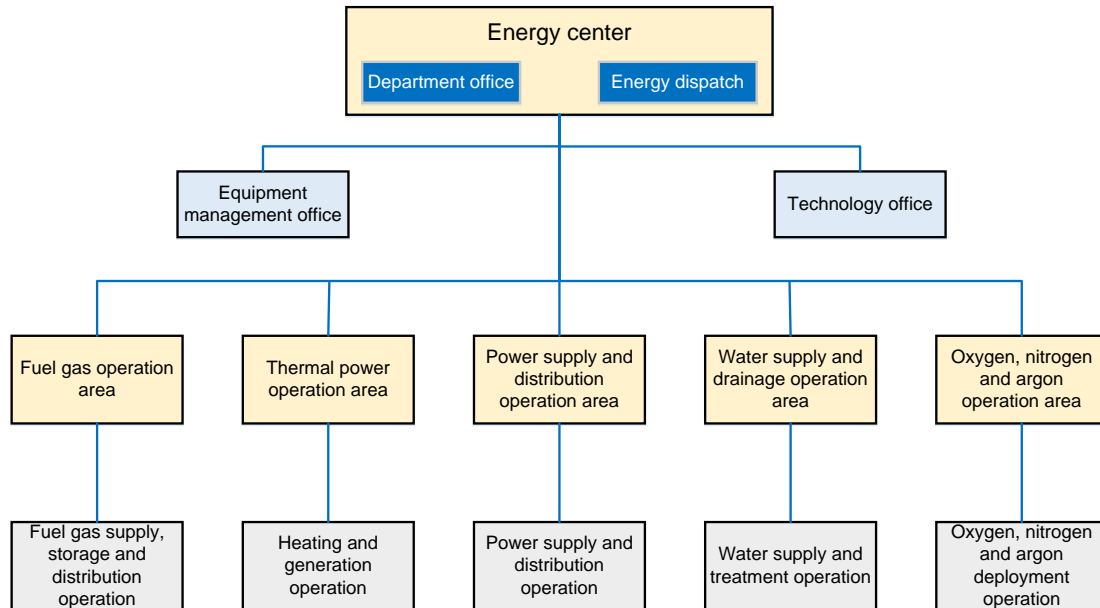


Fig.6. Energy management structure of Case model 1

Case model 2 is based on Hunan Valin Xiangtan Iron and Steel Co., Ltd., as shown in Fig.7. The department of energy located on superior level of power plant is set up to treat energy management among all management affairs. And power plant is in charge of energy dispatch to balance energy supply and use. There is quite clear management level under this model but limited energy dispatch permission as energy center belongs to power plant. So the efficiency of energy dispatch can't be guaranteed. Commissioners from department of energy should be need to guarantee the energy dispatch permission of energy center for improvement of Case model 2.

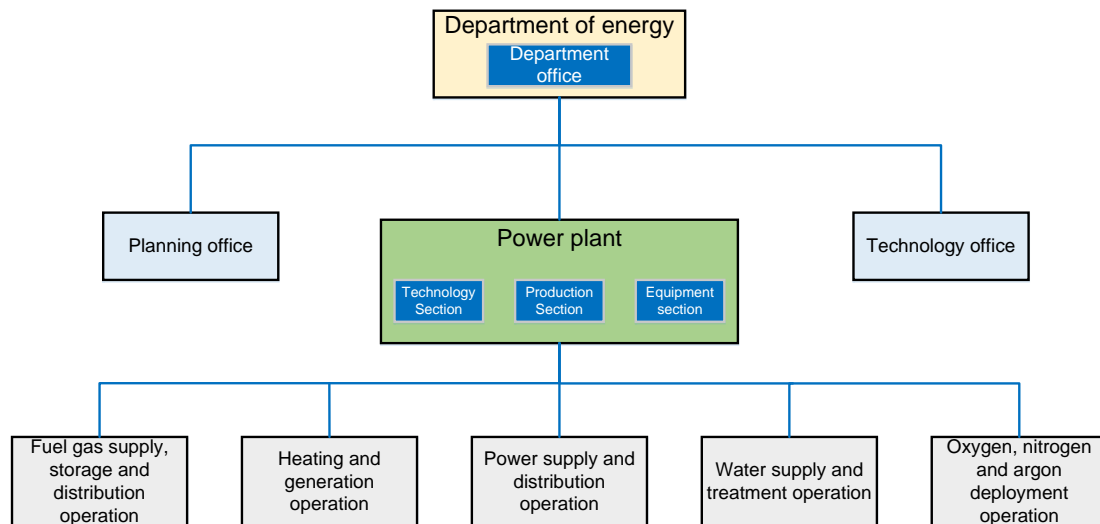


Fig.7. Energy management structure of Case model 2

Case model 3 is based on WISCO headquarters as shown in Fig.8. It's only a modification of traditional management structure. Commissioners from top management department are arranged to treat the energy management in energy center. Fast management transition and adaption have brought poor energy saving effect. A totally reconstruction is needed to improve the energy management structure and total flat structure will be the ideal reference.

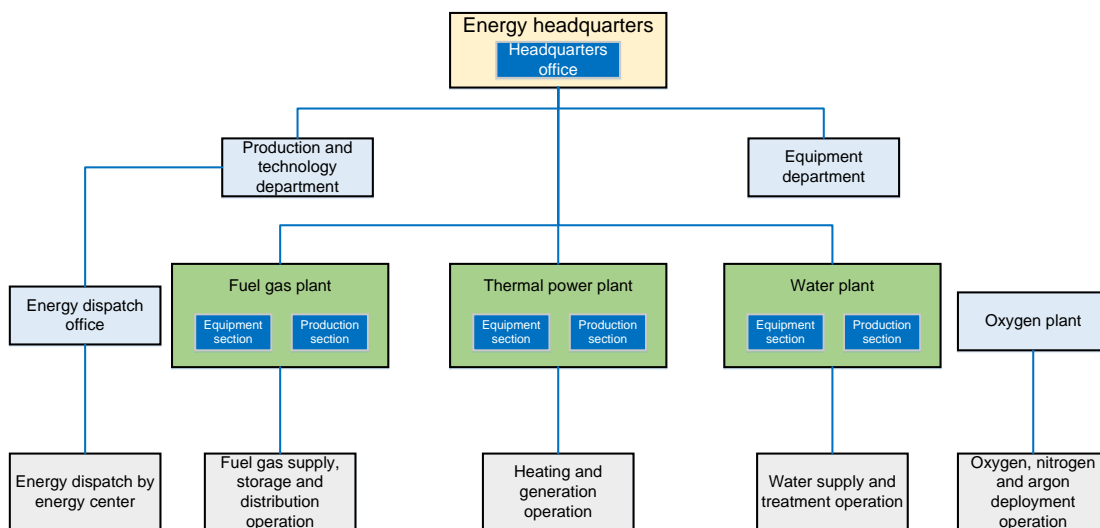


Fig.8. Energy management structure of Case model 3

5. Conclusions

In order to achieve better energy management efficiency and give full play to EMS's value, the iron and steel enterprises in China must conduct energy management structure renovation. Hierarchical management structure has restricted the energy management efficiency as energy dispatch permission can't be guaranteed. When iron and steel enterprises in China are moving forward to informationized energy management, the management structure dose need transformation into flat management structure. The various flat energy management structures provided in this investigation are well worth as references for iron and steel enterprises. Total flat structure will be a perfect choice but it's hard to achieve in a short time. Partial flat structures may be better choices for iron and steel enterprises in China now.

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