Design of Comprehensive Energy System Simulation Platform Under the Background of the Park

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Abstract. First, the overall architecture and data structure of the comprehensive energy system simulation tool in the context of the park are introduced. The core optimization method of the integrated energy system is proposed by revising the optimization toolbox in Matlab software. Secondly, the function simulation tool integrates the energy system, and elaborates the collection, analysis algorithm and application of the system function data from multiple display areas. Finally, establish a comprehensive energy system benefit evaluation, and put forward the prospect of comprehensive energy simulation research.

1. Introduction
At present, China lacks a quantitative analysis model for the integration of park-level comprehensive energy systems and energy optimization operations. Most parks have redundant design capacity and low operating efficiency. Equipment selection and systematic plan optimization design, system optimization scheduling, and system comprehensive benefit analysis and evaluation is still immature. Driven by policies, the trading market for secondary energy such as electricity, cold and heat has gradually taken shape, and the number of integrated energy service companies has shown explosive growth. Based on the integrated energy system operation optimization method, this paper builds a system description and optimization simulation analysis tool for the park energy planning, simulates the real-time operation of the park integrated energy system from the aspects of system modeling and load prediction, and provides evaluation services for the park's integrated energy system construction. To provide a basis for decision-making for the construction and operation of an integrated energy system.

2. Architecture design of comprehensive energy system simulation tool

2.1. Overall structure
The user-centered integrated energy service system needs to be integrated with physical networks and information communication control networks with the help of technologies such as cloud computing, information communication, intelligent perception, and big data analysis. The overall architecture of the integrated energy system simulation tool includes three layers: an acquisition layer, a network layer, and an application layer. Based on a unified data platform, it can realize the optimal cost calculation at any time period and the output curve display of each subsystem of the integrated energy system.

(1) Acquisition layer
The acquisition layer of the comprehensive energy system simulation tool includes digital and analog acquisition. The collected content includes electrical quantity, thermal quantity and equipment...
status quantity. The analog quantity collects electrical signals and thermal signals through sensors, and stores and analyzes them to form detection data information. The digital quantity is collected through standardized data format input or manual input.

(2) Network layer
The network layer is collected data and reliable, secure transmission of the base, the upper acquisition layer is connected to the channel layer application. Besides, the network layer uses a wired way to connect the acquisition layer and the application layers.

(3) Application layer
The application layer includes the integrated energy system cost optimization model, photovoltaic cell model, wind power generation model, solar thermal model, battery model, heat storage and cold storage model, electric boiler model, ground source heat pump model, electric refrigerator model, absorption model and gas turbine model, data analysis and display through system operation.

2.2. Data architecture
The data architecture of the comprehensive energy system simulation tool is divided into three layers: data source, supporting data, and analytical data. The data source contains the basic data uploaded from the sensor and imported from other sites; the supporting data is generated based on the data source, and preliminary data screening and format verification are performed, including customer information, historical data, and real-time data; Analysis data is the result of system operation optimization data. An example of input data is shown in Figure 1.

3. Functional design of comprehensive energy system simulation tools

3.1. Overall energy optimization calculation
The simulation tool needs to input the file name, the simulation start time and the total number of simulation days, and click "Run Simulation". Taking an integrated energy system as an example, the starting time is selected on January 1, 2019, and the total number of days is 1 day. The optimal total cost in this scenario is 71,559.859 yuan, as shown in Figure 2.
3.2. Analysis and display of the operation of the integrated energy subsystem

Taking the above-mentioned integrated energy system with a start time of January 1, 2019 and a total number of days as an example, the subsystem view is shown in Figure 3. Pull down menu subsystem including energy, cooling load, the heat load, the hot water, electric chillers, dual mode (cooling mode), dual mode (heating mode), electric pot furnace, ground source heat pump (heat mode), the source heat (cold model type), the energy storage, heat storage, cold storage, and the hot water storage. When a menu is selected energy, there will be similar to Figure 2 of the energy supply and demand curves, comprising a photovoltaic (the PV), power purchase, output to the grid, the electrical load demand curve and the price.

4. Comprehensive energy system simulation benefit evaluation

At present, the domestic and foreign research on integrated energy systems mostly focuses on planning and design, operation control and platform development, etc, and relatively little content is involved in benefit evaluation. This is related to the fact that there is no mature integrated energy
system case for study, even though the design has a relatively comprehensive efficiency evaluation index in addition to the problem of difficulty in obtaining evaluation index data.

In the existing research, the literature evaluated the benefits of CCHP system, gas turbine system, etc. The specific indicators are shown in Table 1.

| First-level indicators       | Secondary indicators | Unit          |
|------------------------------|----------------------|---------------|
| Economic benefit             | Investment cost      | Ten thousand yuan |
|                              | Running cost         | Ten thousand yuan |
| Energy efficiency            | Primary energy Consumption | MWh          |
|                              | Primary energy utilization | %            |
|                              | Annual CO₂ emissions | t             |
| Environmental benefits       | NO₂ years of emissions | t             |

With the implementation of various energy internet demonstration projects and multi-energy complementary demonstration projects in China, the implementation of the comprehensive energy system benefit assessment has certain implementation conditions, it is necessary to establish a scientific and reasonable comprehensive energy system comprehensive benefit assessment index system as soon as possible and propose suitable evaluation methods to ensure the smooth realization of the investment efficiency goals of the integrated energy system.

5. Research outlook

5.1. Modeling and Simulation of Comprehensive Energy System Based on Dynamic Model
At present, physical models for integrated energy systems at home and abroad are usually static modeling, and the dynamic mechanism and optimization characteristics of the system after various types of equipment and energy coupling integration need to be further studied. The modeling and simulation equipment is few and it is difficult to represent the typical shape and operating characteristics of the future integrated energy system. Therefore, it is necessary to build a static and dynamic model collection of physical equipment of a comprehensive energy system containing new equipment such as heat pumps, electricity to produce hydrogen, and ice storage, and to develop a simulation tool for planning and operation of suitable energy-coupled integrated energy systems, in order to promote Theoretical research and demonstration projects were implemented.

5.2. Comprehensive energy simulation optimization under multi-objective planning
In order to achieve coordinated planning and optimization of the integrated energy system, it is not possible to meet the requirements only with the goal of optimal economic efficiency. It is also necessary to consider multiple goals such as systems of renewable energy utilization and system energy efficiency improvement and the multi-constrained multi-objective programming optimization problem. At present, there are relatively few model achievements in the field of multi-objective planning optimization research on integrated energy systems at home and abroad, and the algorithms suitable for solving multi-objective planning optimization problems in integrated energy systems are yet to be further explored. And coupling conditions, dig deep into the comprehensive energy system planning optimization model and explore the applicable solution algorithm.

5.3. Investment Benefit Evaluation Mechanism of Simulation Benefit Evaluation
The investment and construction of an integrated energy system will drive the transformation and development of the energy industry. The entire process of related projects from investment, design to construction and operation will bring significant benefits to the production, utilization and consumption of energy. Therefore, it is necessary to design scientific and reasonable evaluation standards and methods, and establish an investment income evaluation mechanism for the integrated energy system. At the same time, fiscal subsidy policies, tax relief policies, and investment and
financing policies for integrated energy systems should also be formulated and issued as soon as possible to provide a policy environment and market environment for the evaluation of investment income of integrated energy systems.

6. Conclusion
With the continuous development and application of new technologies and new equipment, the structural framework of the integrated energy system is constantly evolving, and the economic, environmental and social benefits that can be brought will become increasingly obvious. With the continuous deepening of theoretical research on China’s energy internet and comprehensive energy systems and the orderly implementation of pilot projects, the implementation of comprehensive energy system modeling and simulation, planning optimization, benefit evaluation, and platform development has good implementation conditions, and it is also necessary to further in-depth in the future. The focus of the research.

Based on the existing research at home and abroad, the paper summarizes the comprehensive energy system simulation tool architecture, tool function design and benefit evaluation, providing reference and reference for the investment planning, construction and operation of the comprehensive energy system project, and is effective. Carrying out the benefit evaluation mechanism of the integrated energy system and platform development and design provide guarantee and support.

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