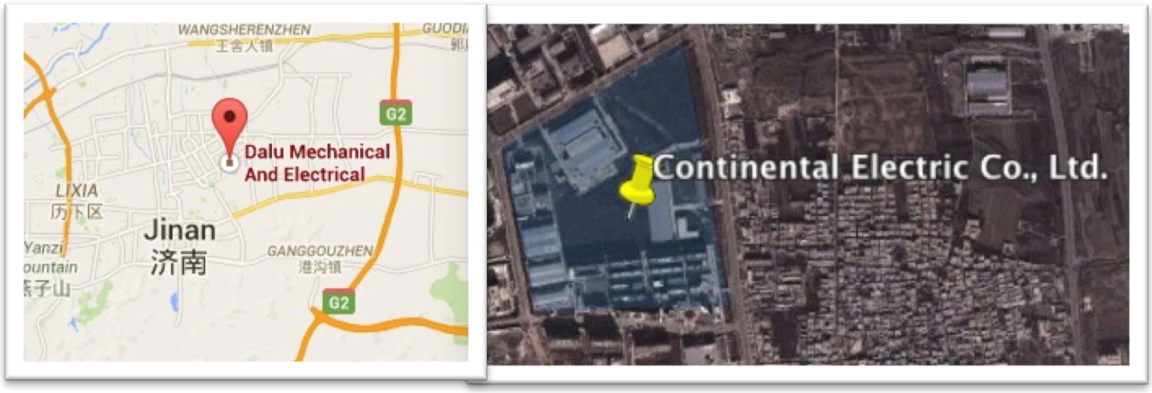
The 2015 US-China Student Energy & Environment Case Competition Case Problems

Case Overview

The 2015 US-China Environmental & Energy features Jinan, a typical Chinese city. The success of eco-city development plans in Jinan could shed light on how other cities in China can embark on their own low carbon development strategies. The scope of cases is also defined to focus on emerging and pressing fields in environmental policy and practices in China. Participants will gain a rare glimpse into contemporary environmental issues in China and develop solutions that are both practical and scalable within the context of Chinese cities.

EECC 2015 has worked closely with Jinan Dalu Electric Manchenism & Electron Co., Ltd. (Dalu M&E) and LBNL China Energy Group to present the case competition problems below. The cases are directly based on current, solvable challenges faced by the company. Some cases rely more on concrete, quantitative problem solving skills while other incorporate a stronger emphasis on design with more open-ended solutions. Ultimately, these problems—like most challenges beyond the classroom—will require both a formal industry knowledge as well as an element of personal creativity, and will seek practical, scientifically sound solutions as the final result.

Dalu M&E specializes in hardware and software, development, system integration of the process enterprise production, automatic control and information management systems. The company is located in the city of Jinan, Shandong province in eastern China. In recent years, Dalu M&E began developing smart buildings and incorporating eco-city components in its office and research facilities. By developing energy efficient buildings and auto-control systems, Dalu M&E has become the pioneer of this field.



Three of the cases concern a multi-functional facility for Dalu M&E, refered to as the Eco-Park. The Eco-Park has a gross area of 10,000 m^2. Design components include electricity, water and heat supply for office buildings, landscape, electricity supply, heating, cooling, sewage, air quality control, transportation and a recreation center. The total employees in the multi-function facility are approximately 5000. The gross area per capita is 20m^2.

Case 4 embraces the full scope of Jinan. Particiannts are expected to use LBNL software BEST & ELITE to propose urban low-carbon development strategy.

Submision Guideline

The written response must be submitted in PDF format through our online platform. If you have any technical problems, please email eecc2015@gmail.com and technical support will be provided within 48 hours.

The response must have a reasonable spacing and font size: single-spaced, Cambria, in size 12. The response must not exceed 10 pages, including graphics, tables, acknowledgements and citations.

Case 1: Indoor Air Quality

Introduction

People spend 90% of their time everyday indoors everyday. Research shows that 2.8 million deaths around the world each year result from indoor air pollution. In recent years, the city of Jinan suffered under severe air pollution. In order to protect the health and well being of their employees, Dalu M&E installed the Variable Air Volume (VAV) control in its HVAC system. It also installed a real-time indoor air quality monitoring system to reduce air pollutants during work hours. The main air pollutants are $PM_{2.5}$ and PM_{10}. The goal is to limit the average concentration of indoor $PM_{2.5}$ to 20um/m^3 or less, PM_{10} to 50um/m^3 or less, and CO_2 to 700ppm or less. Other than the standard limits of air pollutant concentrations, the indoor temperature and moisture content should meet the indoor air quality requirements. Other air pollutants such as O_3 and CH_4 should also be taken into consideration.

Challenge

By analyzing the VAV, CAV systems and the indoor air filters used in the office buildings, a business model can be developed to apply these technologies to other office buildings and hotels in the market. Based on the following criteria, please design your business model to ensure that both the indoor air quality and thermal comfort are within the standards of the given building. The answer should address at least 3 of the following 5 questions:

1. Assuming that the building does not have any air conditioning system or air filters installed, based on the basic parameters of the building, such as the airflow, window surface area, and indoor air temperature, develop air ventilation and conditioning system. Include all assumptions and data calculations if needed.

2. Include a proper VAV system, moisture control, and air filters in your HVAC design to meet the indoor air quality standard. Analyze the advantages and disadvantages of each design option and identify your choices. If your design includes a ground-source heat pump as a heating and cooling source, include the pump design and its overall efficiency.

3. Identify the ways to reduce the energy consumption through airflow.

4. Design the moisture control equipment if possible.

5. Estimate the total cost for the design and include a cost-benefit analysis.

Case 2: Reuse of greywater and rainwater resources

Introduction

Jinan is also named as "the fountain city" because of its famous natural fountain called Baotu Fountain. However, due to the increase of water consumption per capita and the overexploitation of underground water, the water level in the Baotu Fountain continues to decline. It is urgent that the Jinan government understands how to effectively use water resources and save the hundred-year-old fountain. Greywater and rainwater, two kinds of non-traditional water resources, have slowly entered into consideration.

Grey water, which occupies a large percentage of sewage water, contains low oxygen levels and has a high reusable value. However, grey water reuse has not been given serious attention, as grey water is mixed with black water and other wastewaters containing high nutrients that are drained into the sewer system. It is not only a waste of water resources, but also lowers the efficiency of wastewater treatment. Rainwater, the other kind of untraditional water source, should also be properly reused. Statistics show that Jinan's annual precipitation is about 672.7mm. However, the waterlogging phenomenon happening in Jinan cannot be ignored. The introduction of rainwater into daily life can replenish existing water resources, and also transform a wasteful product into a precious one.

Challenge

For this case, participants are required to conduct research on non-traditional water resources, greywater and rainwater and flush out a water recycling solution that provides water for vegetation and toilet use in the Eco-Park. Particpants should follow the instructions below.

1. Please take into consideration water quantity, water quality, economic factors, and social factors to find the most efficient usage of water resources.
2. Participants may focus on the topics of greywater reuse or rainwater gardens.

Case 3: Distributed Generation in the Eco-Park

Introduction

Distributed generation commonly refers to power generation (ranging from several kilowatts to hundreds of megawatts) in small, distributed units that are constructed and operated near their point of use. Since the end of 2012, distributed generation through photovoltaic (PV) panels has gained significant attention in China. Distributed PV generation can be initiated at the grassroots level, with a system for excess power to be fed back into the grid with automatic load balancing. The scope of power generation for distributed generation now includes natural gas, biomass fuel, wind energy and other renewable energy sources. However, non-renewable power sources such as liquid or gas-fueled internal combustion engines and microturbines can also be used.

Challenge

According to the data provided and considering the circumstances of the Eco-Park, design a full range of solutions for distributed generation. Particpants should follow the instructions below.

1. Perform a review of the general benefits and constraints of distributed generation and take into consideration the following challenges in China:

   China's distribution networks are mostly single-source with a reflective structure, employs speed use/time limit disconnect protection, and is non-directional. After integration, the distributed network will reduce the extent of transmission protection and increase the difficulty of protecting the entire transmission line.

2. The plan should capitalize on the advantages of distributed generation but avoid its shortcomings to achieve a stable and efficient supply of energy.

3. The proposal may consider the requirements of national green building standards and take into account green building incentives provided by the central government and the provincial government of Shandong that give credit to implementation of either solar PV or heat pump.

Case 4: (Policy and Strategy)
Using BEST & ELITE software to
create low-carbon development strategy for Jinan

Introduction

The China Energy Group at LBL (Lawrence Berkeley National Laboratory) has developed BEST (Benchmarking and Energy Saving Tools) and ELITE (Eco and Low-carbon Indicator Tools for Evaluating Cities) software packages to address low-carbon development issues. The software can be used to help policy-makers evaluate and implement low-carbon development strategies.

Challenge

Produce a comprehensive policy recommendation to transform Jinan into an eco-city using both BEST and ELITE software packages and the 2008 Jinan data (provided). You policy recommendation should include a detailed implementation plan and cover the following aspects:

1. The performance of overall and industry-specific low-carbon development for Jinan;

2. An estimate of the potential energy savings and emissions reductions for each industry in Jinan (the savings can be estimated from analyzing case studies where international best-practices and existing national standards were implemented);

3. Based on the output of BEST & ELITE and your results in (2), identify which low-carbon policies to prioritize and conduct research on the financing and human resource aspects of implementing the policy;

4. Conduct detailed research on a certain policy based on Jinan's low-carbon development requirements. Identify the benefits (energy saving, carbon emission, environment impact, social impact etc) of implementing this policy and the required resources (financing, human resources). Create a timetable and detailed plan which identifies the stakeholders and includes a method of monitoring progress.

The software, manual and forms can be downloaded from http://CHINA.LBL.GOV

Instructions on how to download the software:

BEST Cities:

- Download and install the Adobe AIR framework in your computer. http://get.adobe.com/air/
- Download the BEST tool application. https://besttool.s3.amazonaws.com/BEST_Tool.air

ELITE Cities:

- Complete the form on http://china.lbl.gov/tools/elite-cities

Note: BEST Cities is used for assessing local energy use and energy-related CO_2 emissions across nine sectors. ELITE Cities is used for evaluating overall performance based on eco and low-carbon indicators.