

Electric Demand Management

Midwest University is an academic and research institution with 15,000 undergraduate and graduate students.

Facilities department at Midwest U operates a central utility plant to serve its campus buildings. They DO NOT generate any electricity on campus. All electricity is purchased from the local municipal provider MuniElectric. University is responsible for distributing this electricity to campus buildings. They also produce steam for heating and research purposes and chilled water to provide air-conditioning and humidity control.

The University pays \$0.03 per KWH of electricity that is consumed by the utility plant and the campus buildings. In addition, due to capacity limitations MuniElectric also charges the University \$20 per KW of electric demand. The University has a ratchet agreement for electric demand with MuniElectric as follows:

The University must pay higher of the two costs:

- a) 75% of their peak demand set during the previous summer (June, July, August, September) or*
- b) Actual used demand.*

A table (Table 1) of University's last year consumption is available for reference. As can be observed from table 1 higher electric demand during summer becomes a large expense for the university during the non-peak months.

To reduce this cost, Midwest U is evaluating using a steam turbine chiller during the hottest days to reduce the peak electric demand. A steam turbine chiller uses minimum electricity during its runtime and relies on a steam turbine to produce chilled water. Since steam is required during the summer season for research, the only cost to run the steam turbine is the variable cost of additional steam. However, the cost to run the steam turbine chiller is \$200/hour more than a comparable electric chiller for same amount of cooling. The steam chiller can reduce the electric demand by 2000 KW during the very warm days. Table 2 shows the projected electric demand data with 2000 KW of electric demand reduction from the proposed steam turbine chiller.

Director of Facilities has challenged the Utility Operations Manager to answer the following questions:

Questions:

- 1) How many hours can the steam turbine chiller be operated for best cost-effective operation?
- 2) What are the risks associated with steam turbine chiller?
- 3) Are there any other tools to manage university's electric demand?

Table 1: Demand Data from previous year

Month	Actual Electric Demand (KW)	Ratchet Electric Demand (KW)	Cost for Actual Electric Demand (\$)	Cost for Ratchet Electric Demand (\$)	Paid to MuniElectric (\$)	Extra Cost due to Ratchet (\$)
January	8,000	12,000	\$160,000	\$240,000	\$240,000	\$80,000
February	8,000	12,000	\$160,000	\$240,000	\$240,000	\$80,000
March	8,000	12,000	\$160,000	\$240,000	\$240,000	\$80,000
April	8,000	12,000	\$160,000	\$240,000	\$240,000	\$80,000
May	8,000	12,000	\$160,000	\$240,000	\$240,000	\$80,000
June	16,000	12,000	\$320,000	\$240,000	\$320,000	-
July	16,000	12,000	\$320,000	\$240,000	\$320,000	-
August	16,000	12,000	\$320,000	\$240,000	\$320,000	-
September	16,000	12,000	\$320,000	\$240,000	\$320,000	-
October	8,000	12,000	\$160,000	\$240,000	\$240,000	\$80,000
November	8,000	12,000	\$160,000	\$240,000	\$240,000	\$80,000
December	8,000	12,000	\$160,000	\$240,000	\$240,000	\$80,000
Total					\$3,200,000	\$640,000

Table 2: Projected Demand Data with a steam turbine chiller

Month	Actual Electric Demand (KW)	Ratchet Electric Demand (KW)	Cost for Actual Electric Demand (\$)	Cost for Ratchet Electric Demand (\$)	Paid to MuniElectric (\$)	Extra Cost due to Ratchet (\$)
January	8,000	10,500	\$160,000	\$210,000	\$210,000	\$50,000
February	8,000	10,500	\$160,000	\$210,000	\$210,000	\$50,000
March	8,000	10,500	\$160,000	\$210,000	\$210,000	\$50,000
April	8,000	10,500	\$160,000	\$210,000	\$210,000	\$50,000
May	8,000	10,500	\$160,000	\$210,000	\$210,000	\$50,000
June	14,000	10,500	\$280,000	\$210,000	\$280,000	-
July	14,000	10,500	\$280,000	\$210,000	\$280,000	-
August	14,000	10,500	\$280,000	\$210,000	\$280,000	-
September	14,000	10,500	\$280,000	\$210,000	\$280,000	-
October	8,000	10,500	\$160,000	\$210,000	\$210,000	\$50,000
November	8,000	10,500	\$160,000	\$210,000	\$210,000	\$50,000
December	8,000	10,500	\$160,000	\$210,000	\$210,000	\$50,000
Total					\$2,800,000	\$400,000