Converting 15-Minute Interval Electricity Load Data into Reduced Demand, Energy Reduction and Cash Flow

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Energy Knowledge Group

15.5 Symposium
on Improving Buildings in Hot and Humid Climates
December 18. 2007

One Cannot Manage the Assumed or Unknown

- Data is the backbone of optimum, stable operations of just one building or an entire world-wide portfolio.
- Without a properly maintained control system and alarming capability, a historical utility consumption data set is needed as a minimum.
- If a building is "*assumed*" to be operating properly, energy *WILL* be wasted!

The culprits:

- EMCSs/BASs that are not maintained.
- Pneumatic control systems. Solid-state DDC sensors and controllers have:
  - *Have better calibration.*
  - *Have less maintenance.*
  - *The accuracy and reliability of positioning of valves and dampers are more accurate and reliable.*
  - *Permits precise airflow measurements and control that results in energy efficient operation of VAV systems.*

The culprits (continued):

- Programmable thermostats.
  - *Power outage and electrical surges reverts thermostats to factory default settings.*
  - *Are usually in small-to-medium buildings where there is no or inexperienced maintenance personnel.*
  - *Albeit simple to us, store managers are intimidated.*

So what are the solutions?

- A data acquisition system.
  - *Pro-active with alarming and demand-response. Is there staff to maintain and ensure a response?*
  - *Passive. Acquire the data and then evaluate and assess to identify anomalies, equipment operating out-of-bounds, improper temperature setpoints and/or on-off times. Who is going to do this?*
  - *A combination.*

CAUTION!

- If you invest your hard earned cash into a data system, have “someone” with the knowledge to do something with the data.
- Do not just let a computer collect the data and then brag that you are metering your building when nobody is looking at the data, especially large buildings that have sophisticated EMCSs/BASs.

What data and the resulting graph can do for you.

- Verify how your building is operating, especially if you are “assuming” it is operating properly, i.e., give your building an ekg.
- You can measure and verify (M&V) performance contracts or energy efficiency upgrades.
- Optimize equipment operations by submetering individual components such as chillers, pumps, motors, cooling towers, etc.
- Verify utility bills or use the data for cost allocation, sub-billing and utility accounting.

Description of data acquisition systems.

- "Data acquisition or metering" is not the same as "monitoring and control."
- For monitoring and control, different and more costly, hardware infrastructure must be installed to react to alarms (control) generated by the metered points.
- Before you start your data project, ask:
  - *What data do I want?*
  - *What am I going to do with it?*

Components of a data project.

- Meter point hardware (metering devices, equipment).
- Hardware inter-connectivity.
- Central datalogger and control platform, gateway and communications device.
- Data warehouse and hosting.
- Data presentation.

Building Proximity						Building Proximity			Building Proximity	Data Transport Medium		End-User		
End-Point Hardware (Metering Devices, Equipment)						Connectivity			Central Data Gateway Device	Communications		Software		
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

Components of a data project (continued).

- End-point hardware (sensors, CTs, etc.).

Building Proximity					
End-Point Hardware (Metering Devices, Equipment)					
15	14	13	12	11	10
End-Point(s) and Quantity of Each Type	**Type of Activity and Data Required**	**Frequency of Data Acquisition or Type of EMCS/BAS**	**Metering and Other End-Device Hardware**	**Intermediate Communications (Device)**	**Metering Device Data Output Protocol or Personality Module**
Whole-building electric via main electric feed panel.	15-minute data acquisition of building electricity 1.) kWh. 2.) kW. 3.) Power factor. 4.) kVARh 5.) Amps per phase. 6.) Volts per phase. 7.) Outside air temperature.	Data acquired at 15 minute intervals (retrieved once per day)	5 amp secondary output, split-core current transformers	1.) Direct hardwire between end-point and logger, or 2.) Hardwire with RS-485 to LAN node, or 3.) Hardwire with RS-485 to wireless modem, or 4.) Hardwire to building fax line.	5 amp output.

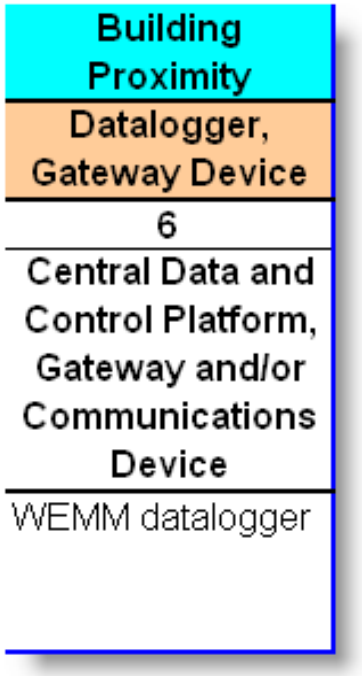
Components of a data project (continued).

- Connectivity.

Building Proximity		
Connectivity		
9	8	7
Connectivity	Intermediate Instrumentation and Equipment	Intermediate Communications Device
RS-485 (RS-232, Ethernet, ModBus are options)	N/A	N/A

Components of a data project (continued).

- Datalogger or gateway device.



Components of a data project (continued).

- Communications.

Data Transport Medium	
Communications	
5	4
Intermediate Communications Device	Communications
Wireless, cellular modem with DHCP.	Cellular.

Components of a data project (continued).

- Software.

End-User		
Software		
3	2	1
Data Warehouse Location for Data Flow and Data Management	**Data Format**	**Software Engine**
1.) EKG computer/Server. 2.) Client based software.	N/A (system is a closed, seamless system).	Energy@Desktop energy software.

What data should be acquired?

- kW, kWh, kVARh, Volts, Amps.
- Outside Air Temperature (OAT); area vs. site-specific.
- Power Factor (can calculate from kVARh or kVAR).
- Peak demand; 4CP.
- Other.
  - *Environmental: humidity, CO_2, temperature, etc.*
  - *Supply/Discharge air temperature, pressures.*
  - *Other utilities: gas, water (domestic, irrigation, etc.).*
  - *All are LEED applicable.*

What are the costs of a data project?

- Datalogger and related hardware costs (CTs, sensors, etc.).
- Remote accessibility (TCP/IP, LAN, dial in/out via a telephone line) and the related costs of the service, i.e., cellular, warehousing of data, Internet fees, etc.
- Location vs. labor availability and their expertise for installation.
- Software.
- Engineering evaluation and assessment of the profiles.

What are the costs of a data project? (continued)

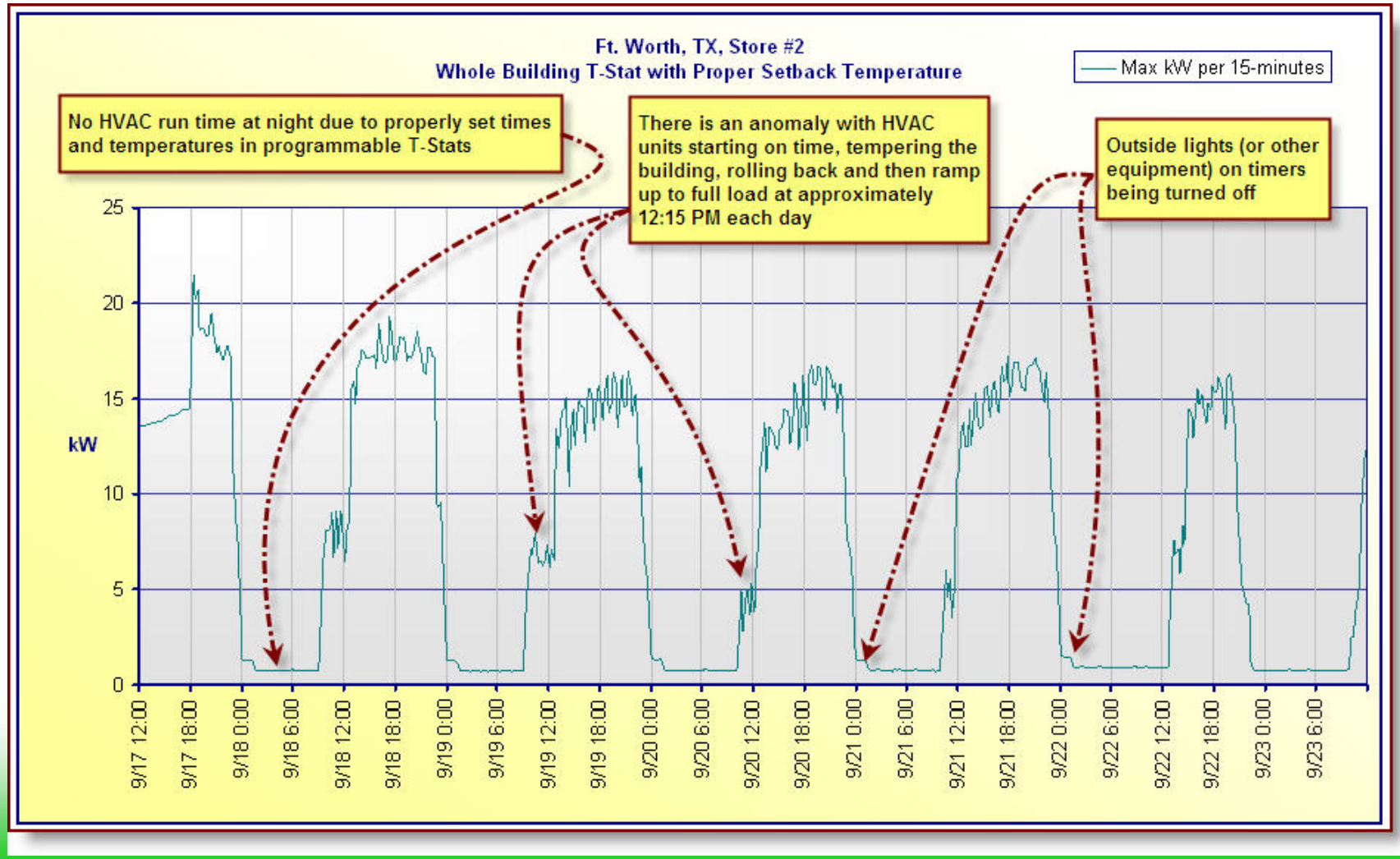
- Localized, onsite loggers can be as low as the $50 - $150 range for each logger.
- Short-term datalogging solutions can range in the order of $2,000 - $3,500.
- Monthly warehousing of data can range from $30 - $75.
- Monthly outsourcing of engineering assessment can be $50 - $250.
- $0 if on-staff personnel has the knowledge.

Retail chain store.

- In September, 15-minute interval electrical load data was acquired for five small retail chain/franchise stores throughout Texas for one month.
- Managed by young people.
- No on-site or outsourced maintenance personnel.
- Programmable thermostats.
  - *Fan in "on" position.*
  - *Factory default settings.*

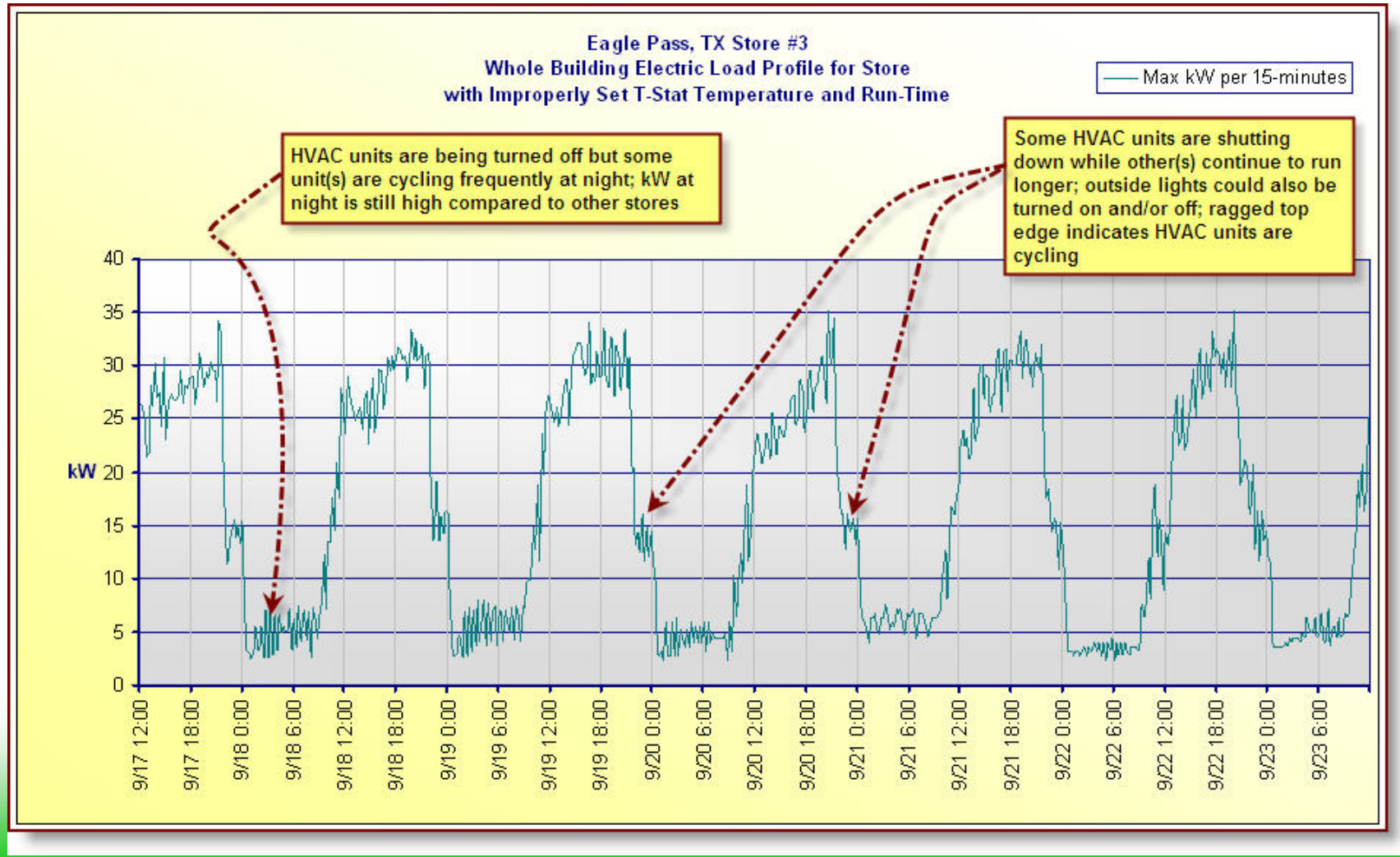
Retail chain store (continued).

- Thermostat with proper setback temperature.



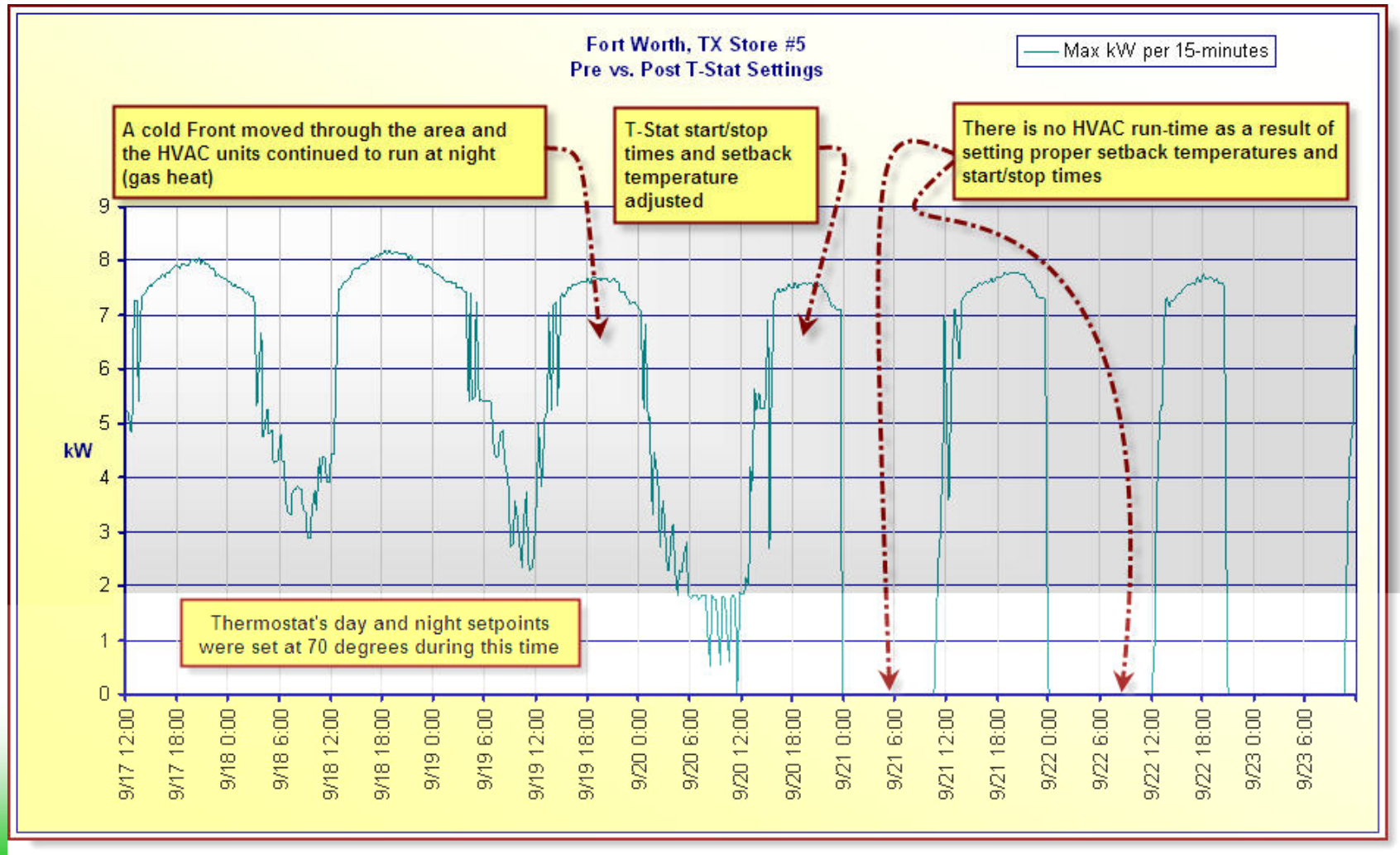
Retail chain store (continued).

- Improperly set thermostat.



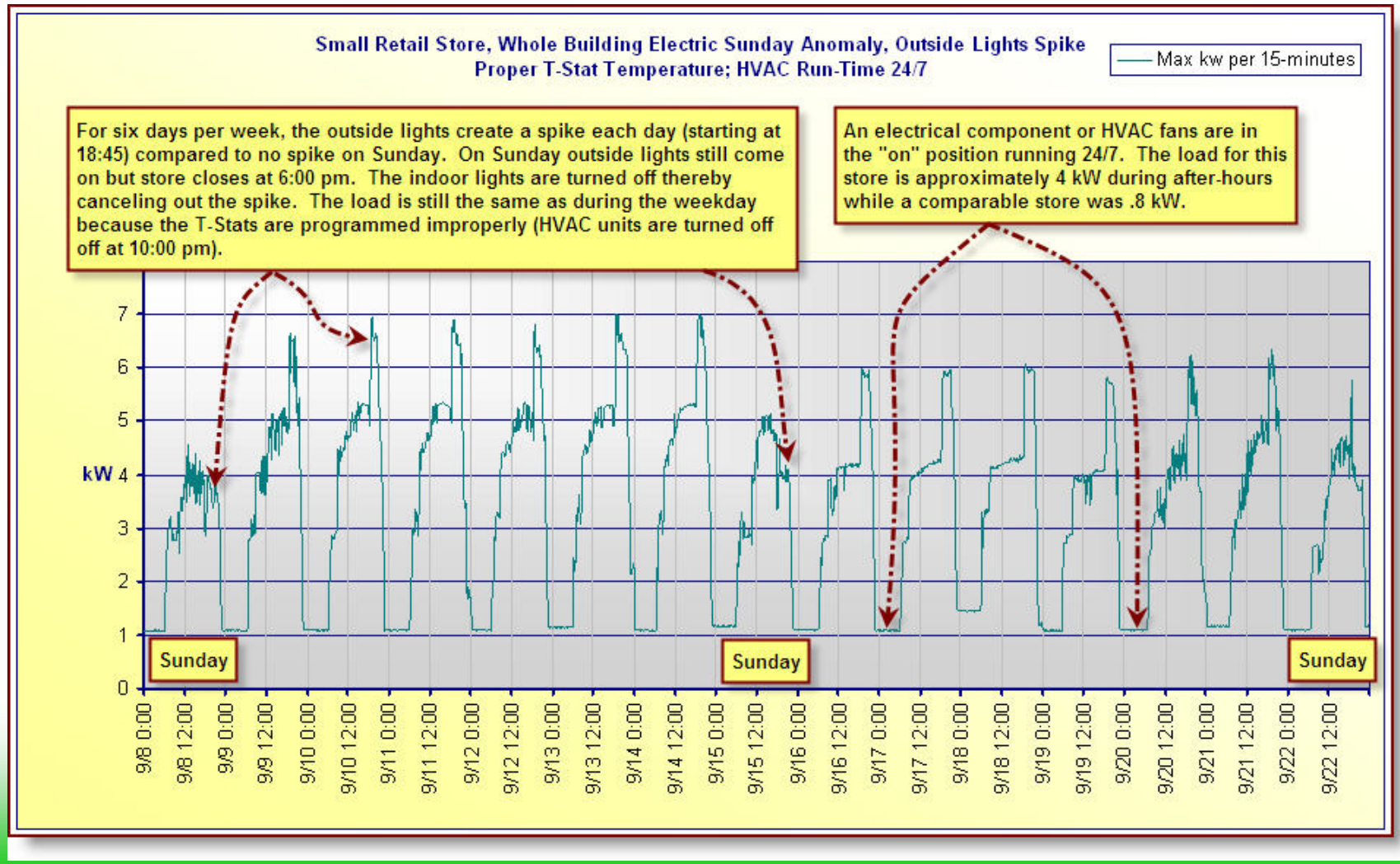
Retail chain store (continued).

- Pre vs. post thermostat settings.



Retail chain store (continued).

- Sunday anomaly and outside light spike.



Retail chain store (continued).

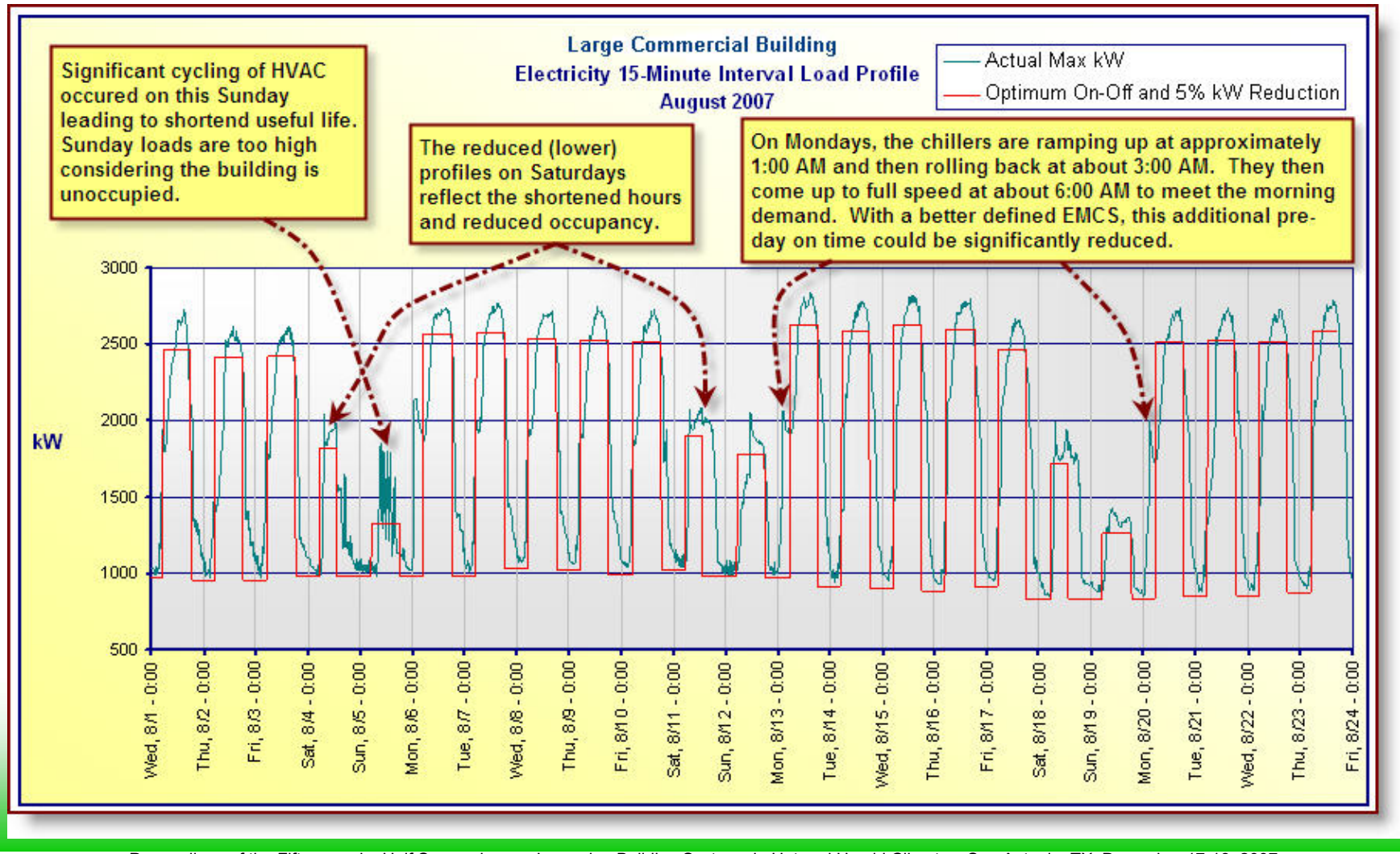
- Recommendations.
  - *Implement a portfolio wide EMCS/BAS with remote access and control of each building's HVAC systems, outdoor lighting and other equipment and components.*
  - *Alarm temperature setpoints and on-off times.*
  - *Index the stores to find the "energy pigs" of the portfolio.*
  - *Use each store's interval data to negotiate a better electricity rate and/or contract by aggregating the loads (if in a deregulated state or city).*

Large commercial building.

- First-class, 3-tower office building with Tower A, the tallest tower at 20 stories high.
- The lower floor plate spans all three towers and is 40,000 sqft/floor. The middle floor plate spans two towers and is 27,000 sqft/floor and the upper floor in the tallest tower is 14,000 sqft/floor.
- Three chillers and electric heat provide comfort cooling/heating.
- A pneumatic-to-DDC signal EMCS provides control of the HVAC system. No energy metering or trending.

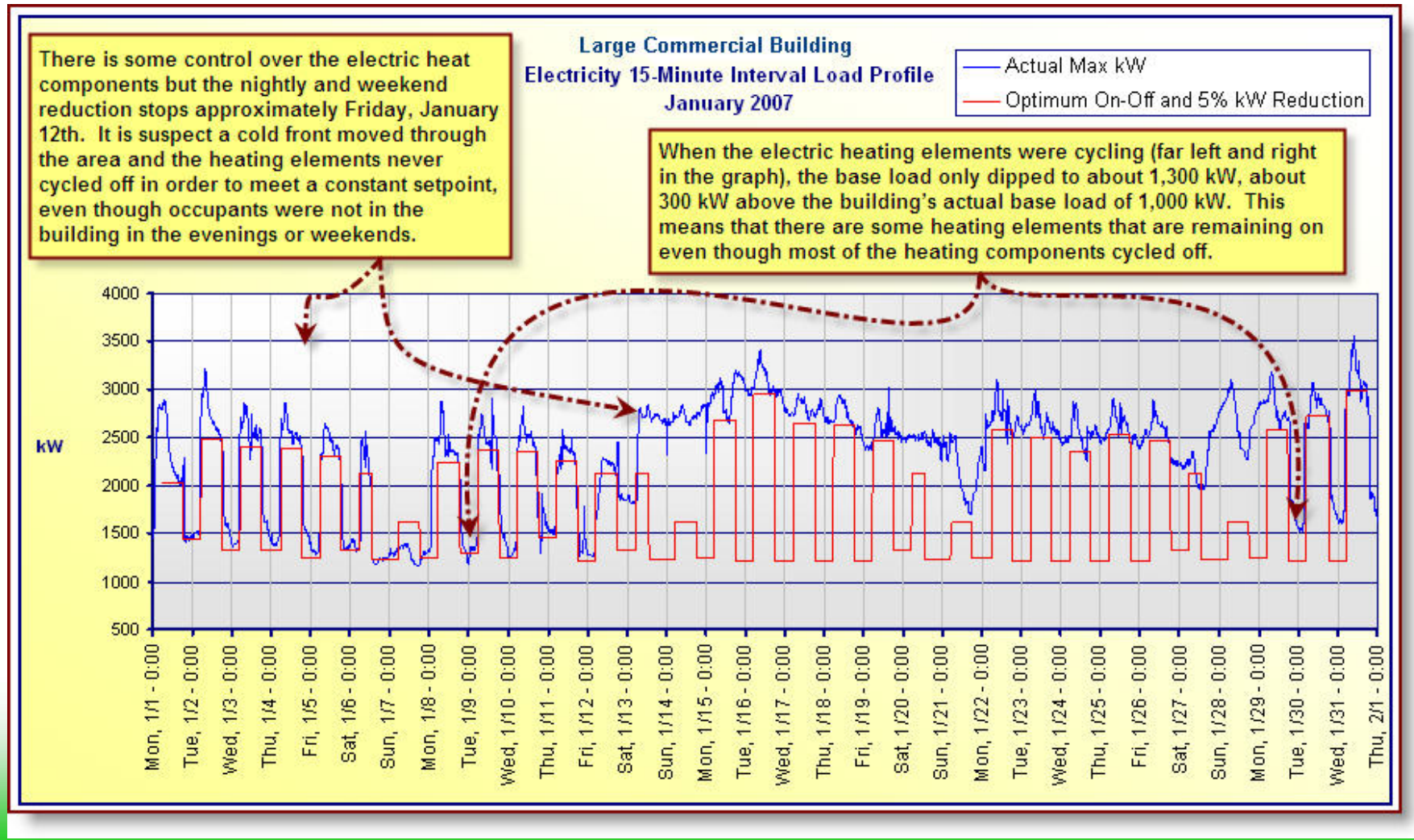
Large commercial building (continued).

- Summer month.



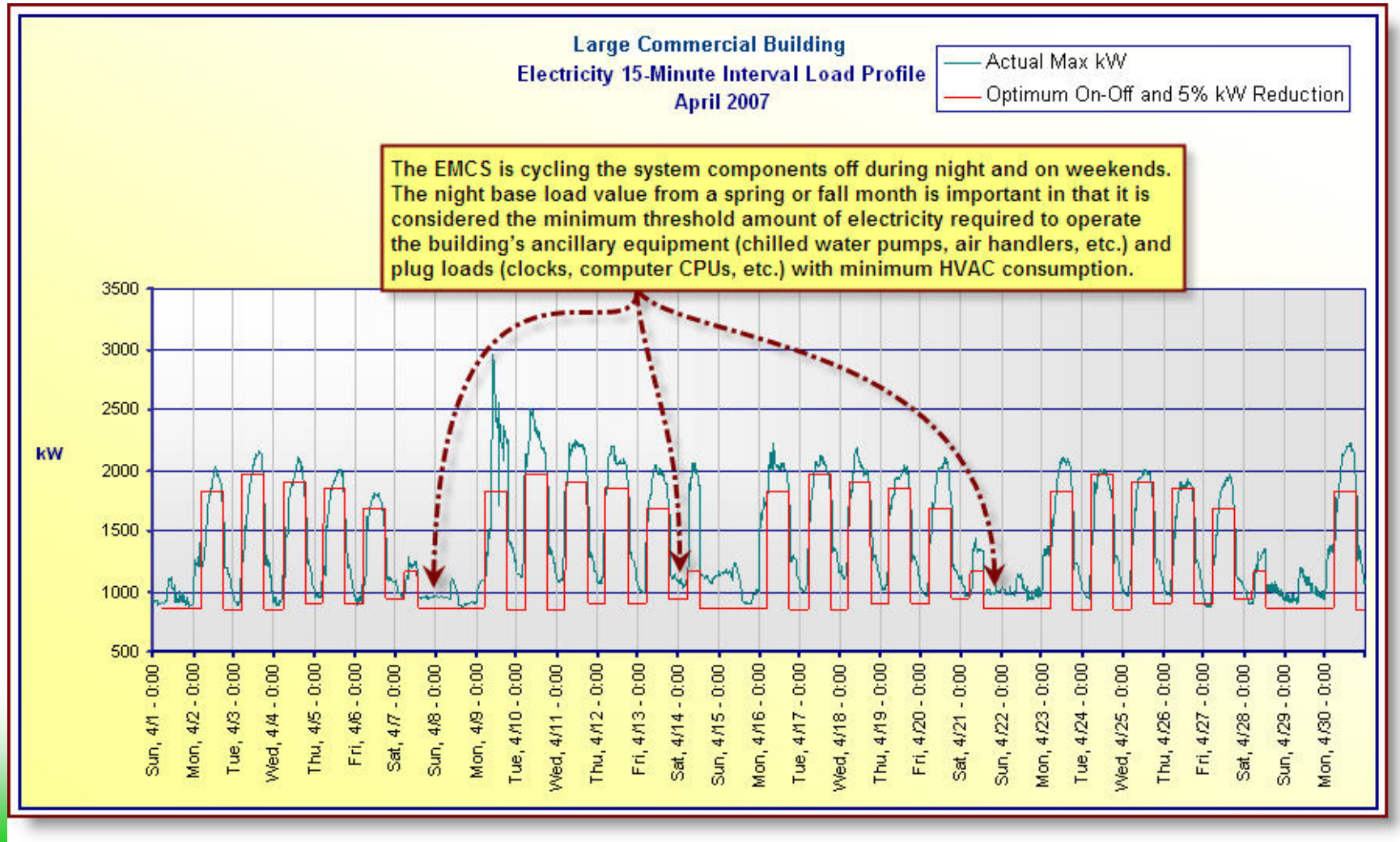
Large commercial building (continued).

- Winter month.



Large commercial building (continued).

- Shoulder month.



Large commercial building (continued).

- Recommendations.
  - *EMCS should be re-commissioned as a minimum and possibly transition to a full DDC system.*
  - *Install a data acquisition system or activate the energy trending and presentation component of the existing EMCS/BAS.*
    - *Optimize HVAC runtime and operational efficiency by alarming daily on/off times and temperature setpoints for different areas of the building. Acts as a verification tool to ensure EMCS/BAS is operating properly.*

Large commercial building (continued).

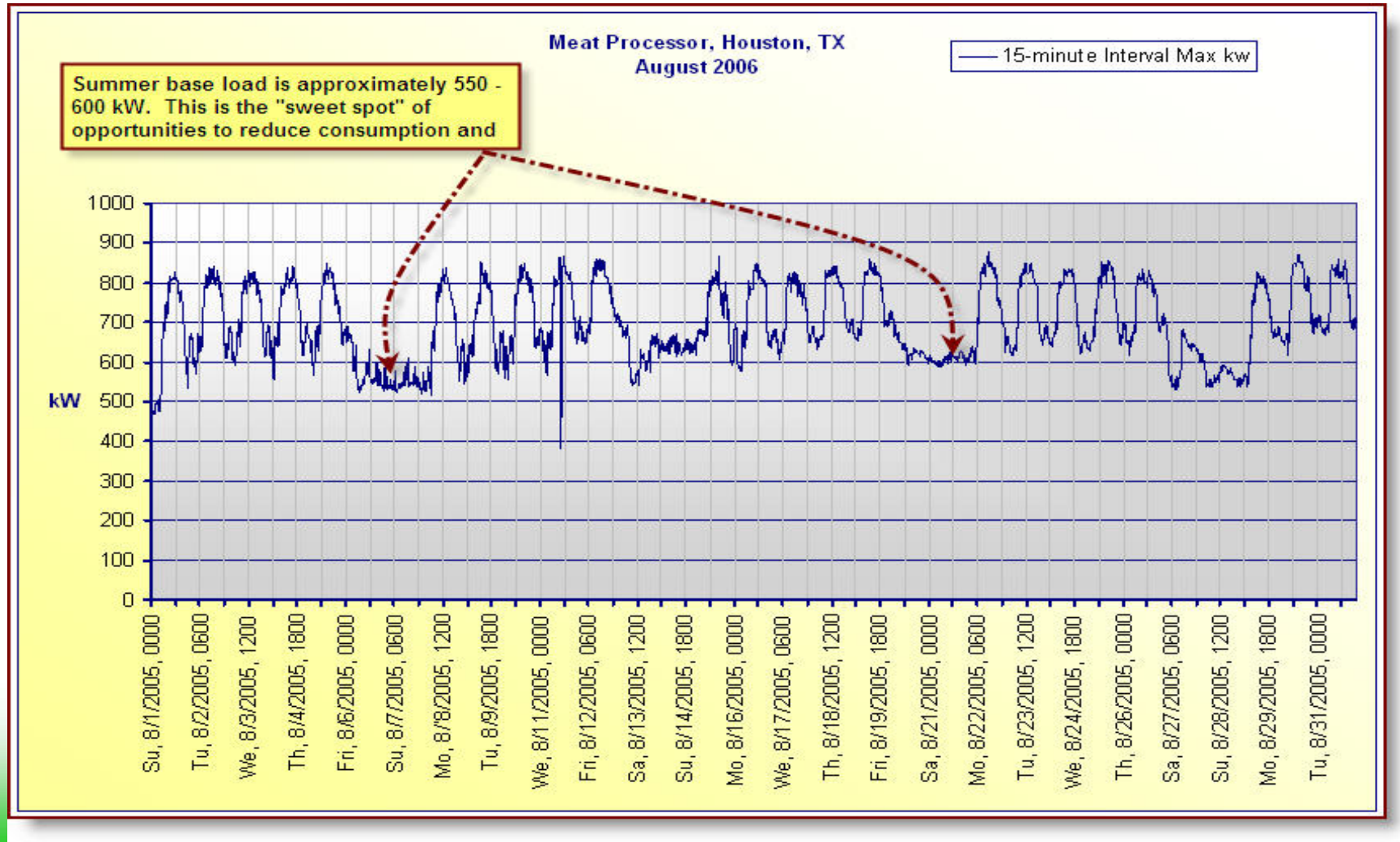
- Recommendations.
  - *Leverage annual interval data to negotiate a more favorable electricity rate when the existing electricity contract ends.*
  - *Power Factor is 86%. Correct to 95% to reduce Power Factor penalties by TDSP.*
  - *Install ECMs or equipment to shift or eliminate the loads during periods of the electric grid's peak demand to reduce 4CP demand charge costs.*

Meat processing plant.

- Location is Houston, Texas.
- The facility uses ammonia system for their refrigeration and rooftop units (RTUs) for their office comfort cooling.
- The company works two shifts and no weekends.
- A significant base load as a result of the required refrigeration load 24/7. The average kW load for the facility's compressor motor load is 485 kW.
- The base load ranges from about 300-600 kW.
- There is no EMCS/BAS or data acquisition system.
- On-staff, very astute facility engineer.

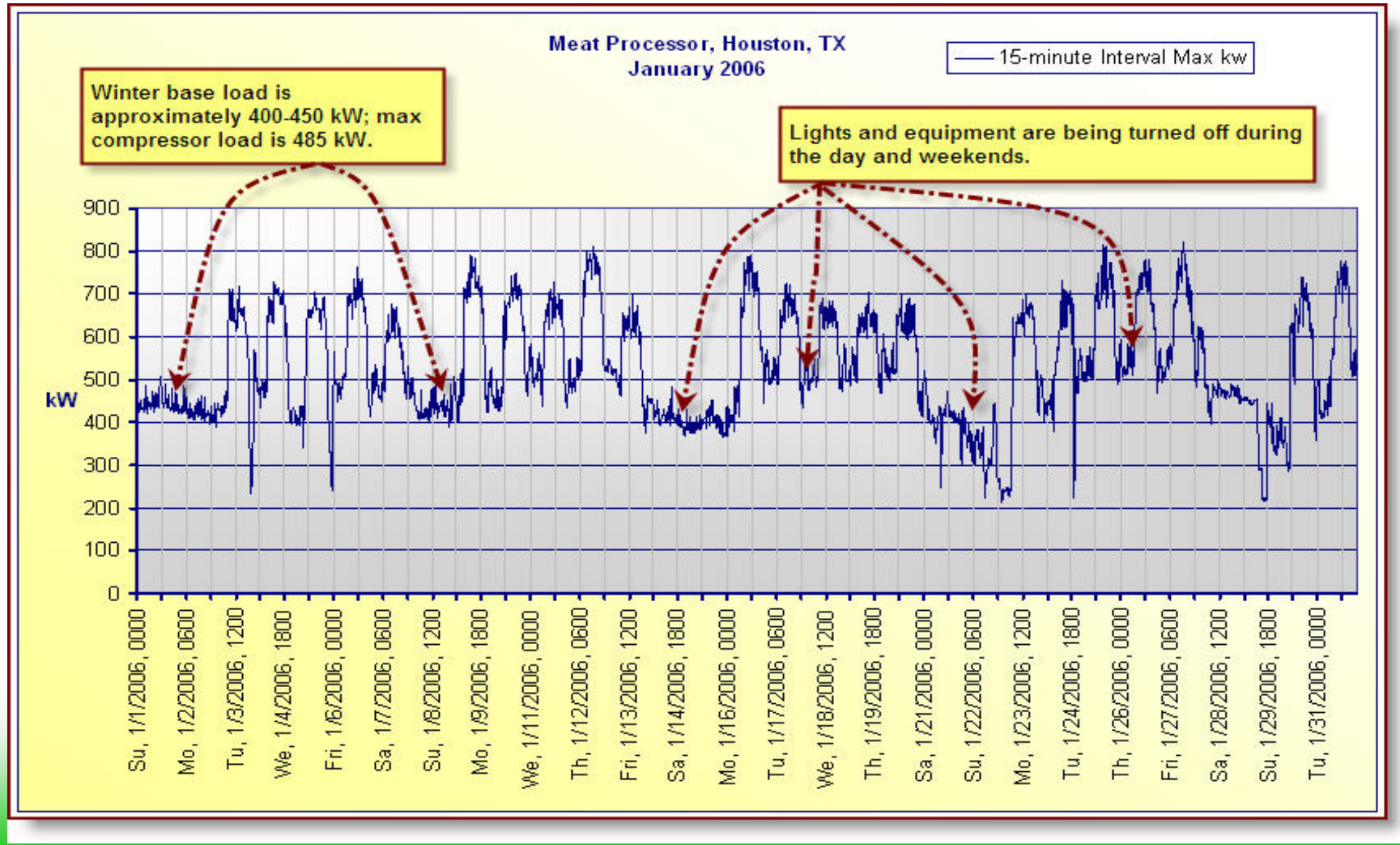
Meat processing plant (continued).

- Summer month.



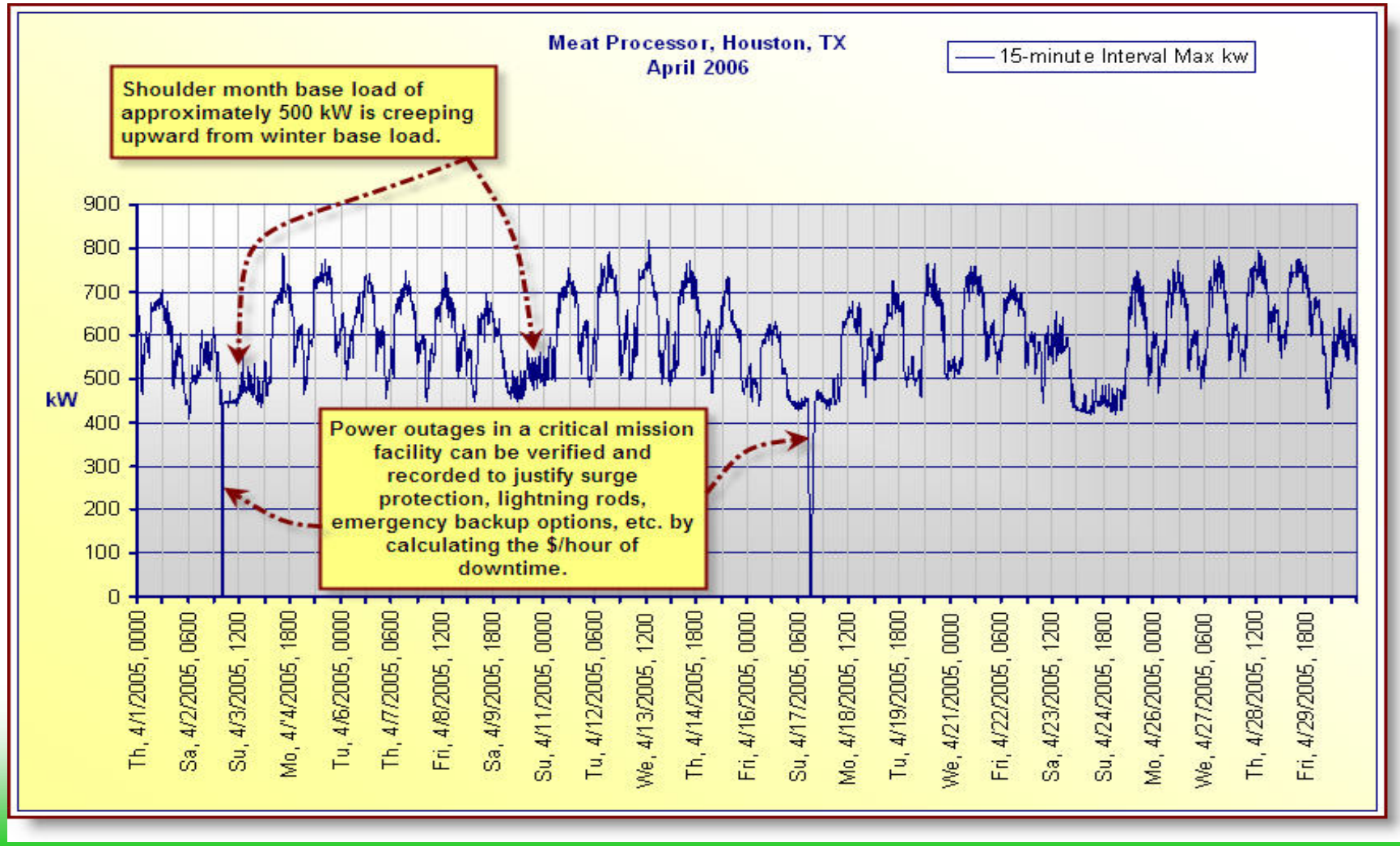
Meat processing plant (continued).

- Winter month.



Meat processing plant (continued).

- Shoulder month.



Retail processing plant (continued).

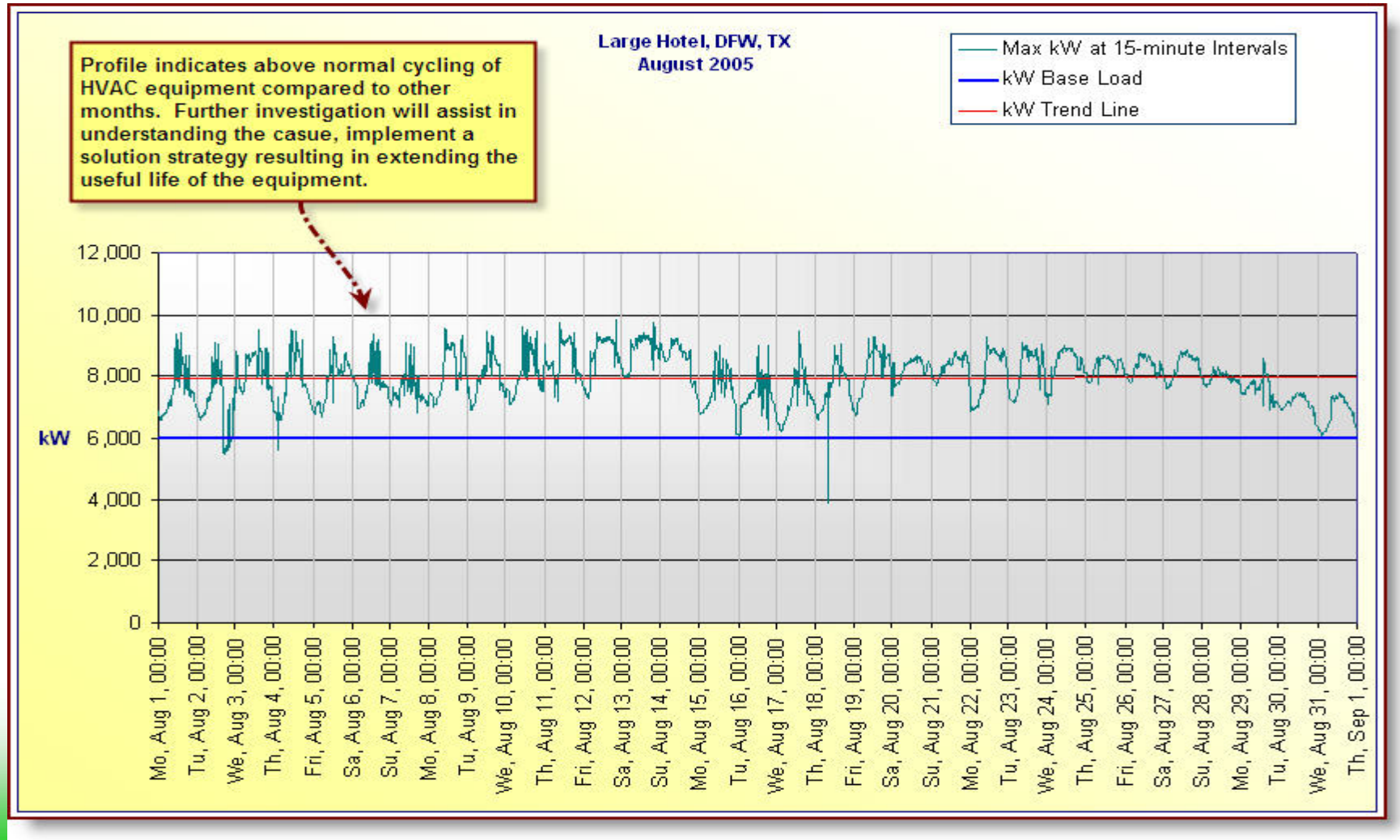
- Recommendations.
  - *Implement measures that will avert the compressor load. Rewire so they are on isolated electrical panels and then allow a renewable energy source such as solar to power each sub-load.*
  - *Install ECMs or equipment to shift or eliminate the loads during periods of the electric grid's peak demand to reduce 4CP demand charge costs.*
  - *Power Factor is 90%. Correct to 95% to reduce Power Factor penalties by TDSP.*
  - *Install a data acquisition system.*

Large hotel.

- A premier resort hotel and convention center with over 1,500 guest rooms, 400,000 sqft of exhibit hall and meeting room space, ten restaurants and over 2,000 employees.
- The chillers and other comfort cooling equipment are controlled by a DDC BAS.

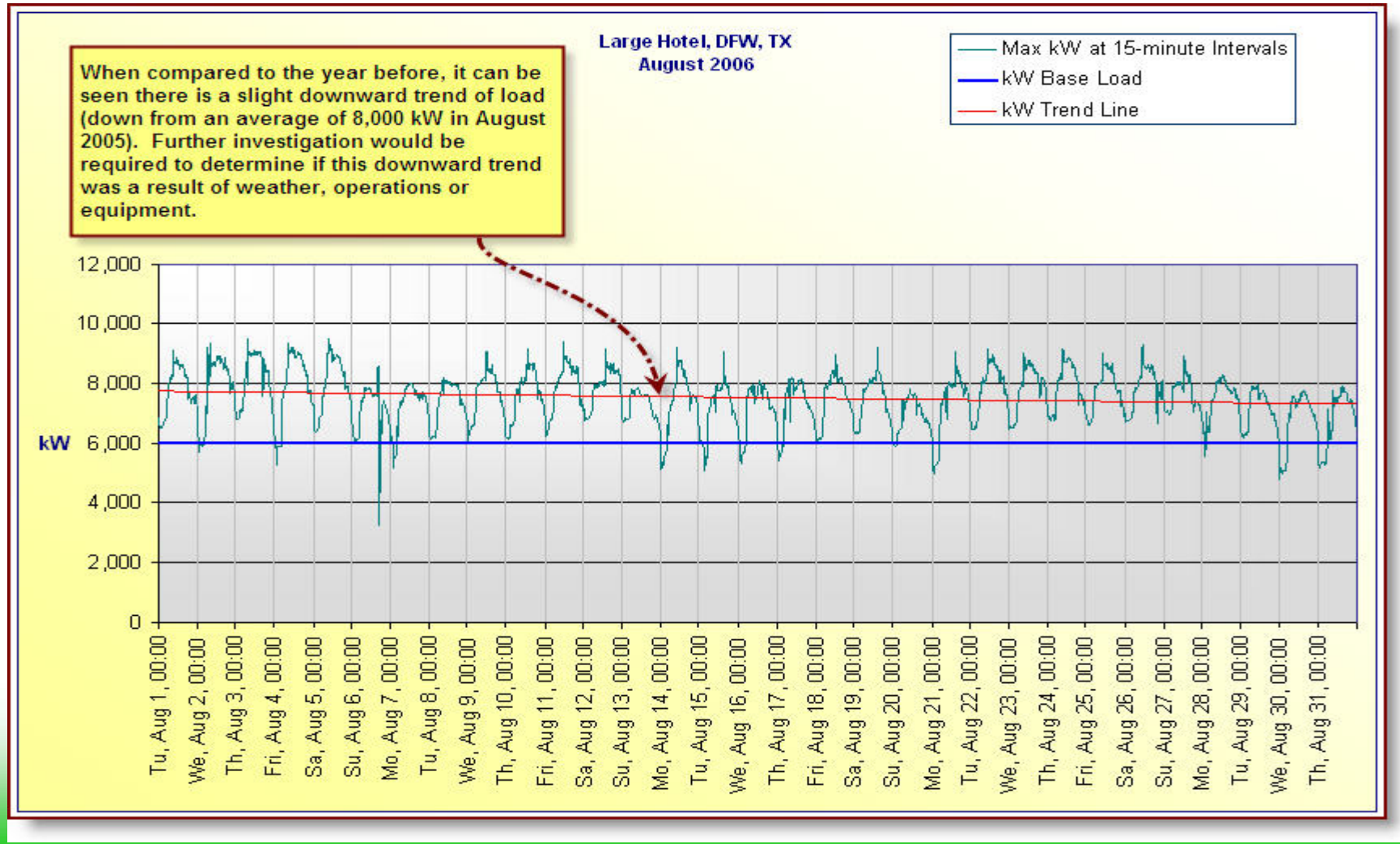
Large hotel (continued).

- Summer month.



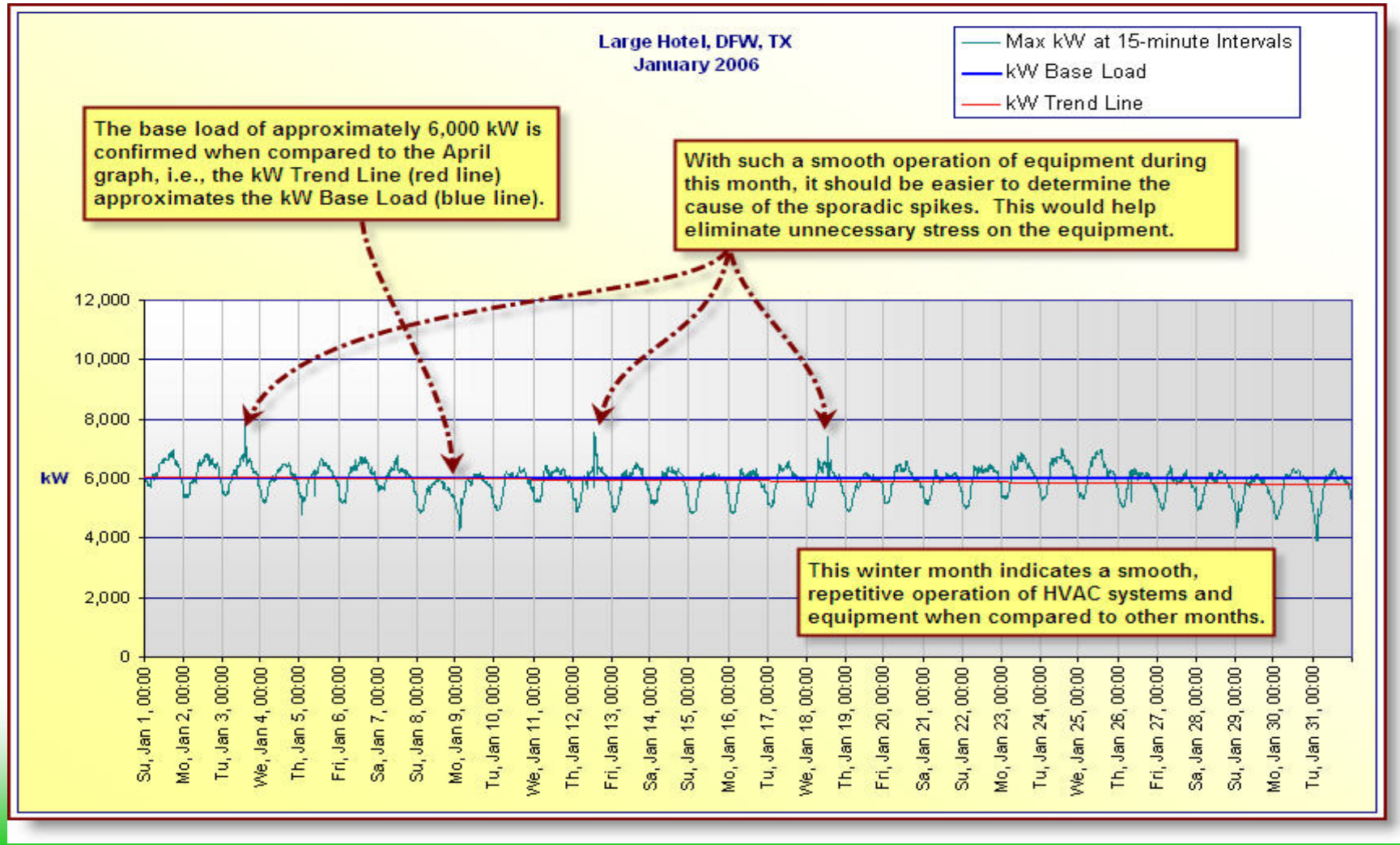
Large hotel (continued).

- Summer month comparison.



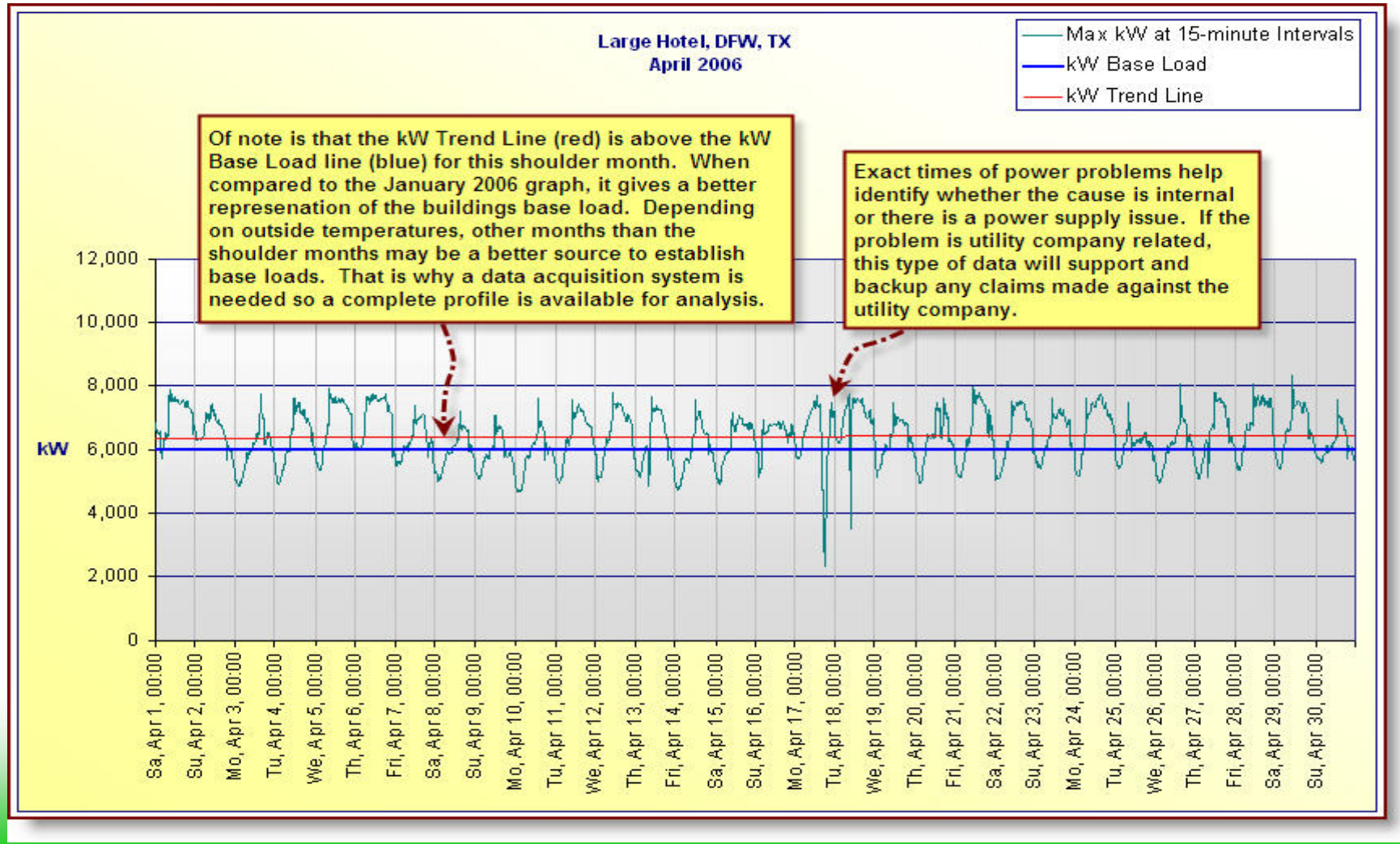
Large hotel (continued).

- Winter month.



Large hotel (continued).

- Shoulder month.



Large hotel (continued).

- Recommendations.
  - *The BAS should be re-commissioned to ensure optimum setpoints and times.*
  - *Install a data acquisition system or activate the energy trending and presentation component of the existing EMCS/BAS (haven't done so yet due to internal issues).*
    - *Optimize HVAC runtime and operational efficiency by alarming daily on/off times and temperature setpoints for different areas of the building. Acts as a verification tool to ensure EMCS/BAS is operating properly.*

Large hotel (continued).

- Recommendations.
  - *Leverage annual interval data to negotiate a more favorable electricity rate when the existing electricity contract ends.*
  - *Better allocate energy costs associated with convention and meeting events.*
- *Power Factor is 90%. Correct to 95% to reduce Power Factor penalties by TDSP.*
- *Install ECMs or equipment to shift or eliminate the loads during periods of the electric grid's peak demand to reduce 4CP demand charge costs.*

Remember: One Cannot Manage the Assumed or Unknown

Data is knowledge…and knowledge is the power to reduce your energy spend!

Questions and Comments…

Thanks!