

**The 19th International Conference on  
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**ELECTRICITY CONSUMPTION COMPARISON OF MECHANICAL AND  
ELECTRONIC THERMOSTATS**

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OUTLINE

***1. Introduction***

- i. Electricity Consumption*
- ii. Energy Saving*

***2. Problem Definition***

- i. Commercial Refrigerator Cabinets*
- ii. Mechanical & Electronic Thermostats*

***3. Measurements***

- i. Mechanical Thermostats*
- ii. Electronic Thermostats*

***4. Results & Conclusions***



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## 1. INTRODUCTION

- ✓ Energy requirement is one of the most fundamental problems all the world.
- ✓ Today, the need for energy is increasing day by day. To meet this need, many projects are being developed around the world and efforts are being made to increase production capacity according to the need through various methods.
- ✓ In addition, efforts are being made to make the systems consume less energy by considering energy efficiency in existing systems.
- ✓ One of the common areas of use of energy is the cooling sector. Making these products, which are used in many places in our daily lives, both domestic and industrial, energy efficient is critical for energy saving.
- ✓ This study was conducted to reveal the effect of thermostat selection on electricity consumption using commercial refrigerator cabinets

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## 1. INTRODUCTION

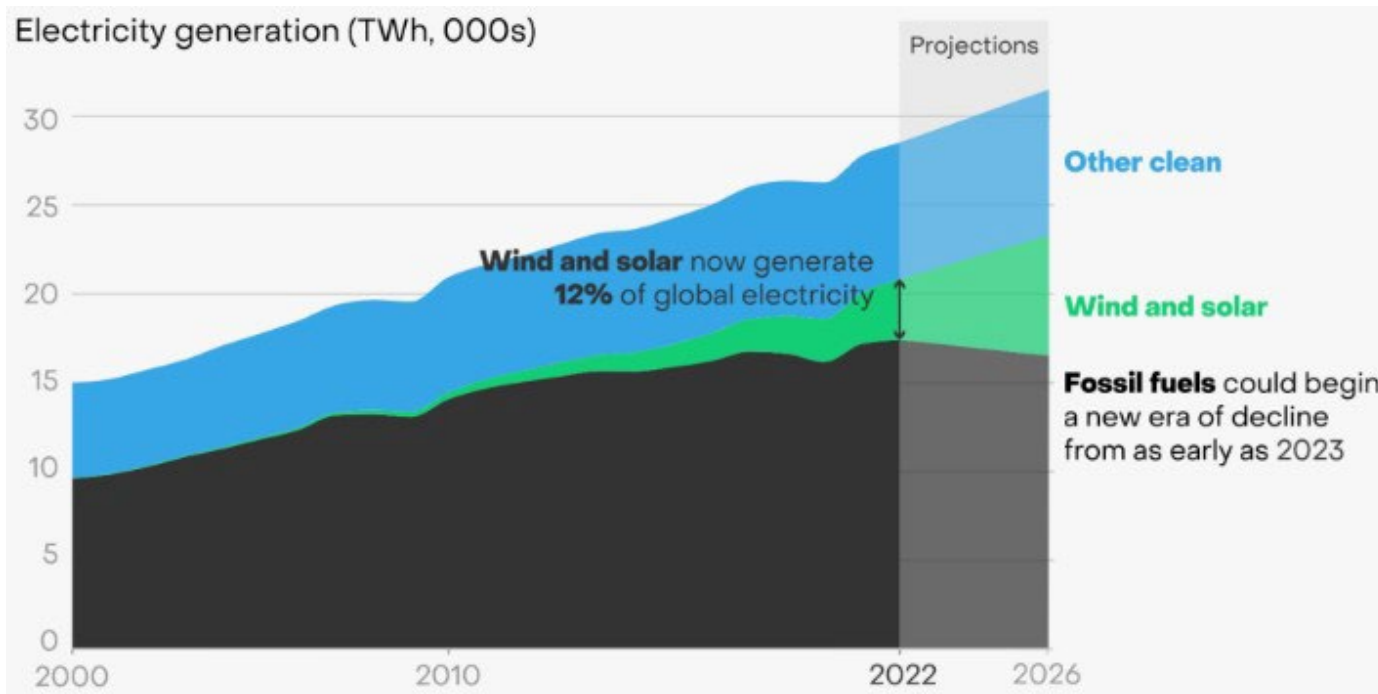


Figure 1. Electricity generation and future projection [2]

- ✓ In a report published in 2019, total electricity consumption of the whole world reached 22848 TWh and this represents to 1.7% increment from previous year.
- ✓ Moreover, one year later, in 2019, total electricity consumption of OECD was 9672 TWh. This is 1.1% lower than the total consumption reported in 2018.
- ✓ On the other hand, electricity consumption of the other countries was 13176 TWh, which represents 3.8% increment from 2018 [1].
- ✓ In parallel with this need, electricity production is increasing day by day. According to the “Global Electricity Review 2023” report of Ember, in 2022 the global electricity generation was 28K TWh [2].

[1] <https://www.iea.org/reports/electricity-information-overview>

[2] <https://ember-climate.org/insights/research/global-electricity-review-2023/#supporting-material>

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## 2. COMMERCIAL REFRIGERATOR CABINETS

- ✓ “According to [Energy.gov](https://www.energy.gov), commercial refrigerators can use up to 17,000 kilowatt-hours of electricity, while commercial freezers can use up to 38,000 kilowatt-hours of electricity.
- ✓ To put those values into perspective, a typical U.S. house uses on average [10,399 kilowatt-hours per year.](#)” [10]
- ✓ This represents the situation only for USA but commercial refrigerators are commonly used all over the world.



Figure 2. Typical commercial refrigerator cabinets [11]

[10] <https://www.partstown.com/cm/resource-center/guides/gd2/how-much-energy-does-a-commercial-refrigerator-use#:~:text=How%20Much%20Energy%20Does%20Commercial,38%2C000%20kilowatt%2Dhours%20of%20electricity>

[11] <https://www.webstaurantstore.com/refrigeration-equipment.html>

## 2. COMMERCIAL REFRIGERATOR CABINETS

- ✓ The thermostats are used to control temperature by working as a switch.
- ✓ Thermostats can be mechanical or electronic but nowadays electronic thermostats are preferred frequently.
- ✓ In general older devices use mechanical thermostats whereas new devices use electronic thermostats.
- ✓ Mechanical thermostats use mechanical parts to sense temperature changings whereas electronic thermostats use electronic sensors for thermal measurements.

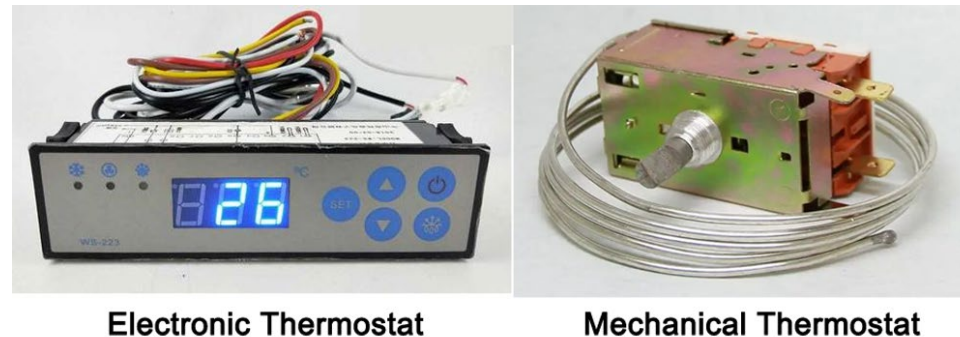


Figure 4. Electronic and Mechanic Thermostats [19]

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## 3. MEASUREMENTS

- ✓ For the electricity consumption measurements of commercial refrigerator cabinets while using electronic and mechanical thermostat, standardized test procedure is applied.
- ✓ Cabinet is loaded with soft drink boxes as shown in Figure 5.



Figure 5. Installed Version of Double Door Commercial Beverage Cooler

- ✓ This cabinet is first installed with electronic thermostat and then measurements done. Then, same cabinet with same sensors, loads etc is installed with mechanical thermostat and measurements are repeated.
- ✓ Cabinet inner temperatures (temperatures of each shelf and all drink boxes separately, total of 30 boxes) are measured during 24 hours as 1 measurement/minute.
- ✓ Energy values are measured using a energy analyzer.

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## 3. MEASUREMENTS

- ✓ In the following figures measured temperature and electricity consumption plots are given.
- ✓ The measurements hold for 24 hours (1 measurement/minute) but for the visibility of the figures, only 12 hours and 3 hours portions are included here.
- ✓ In Figure 7, the electricity measurements from energy analyzer for both cases (mechanical and electronic thermostat cases) are given for 12 hours only.



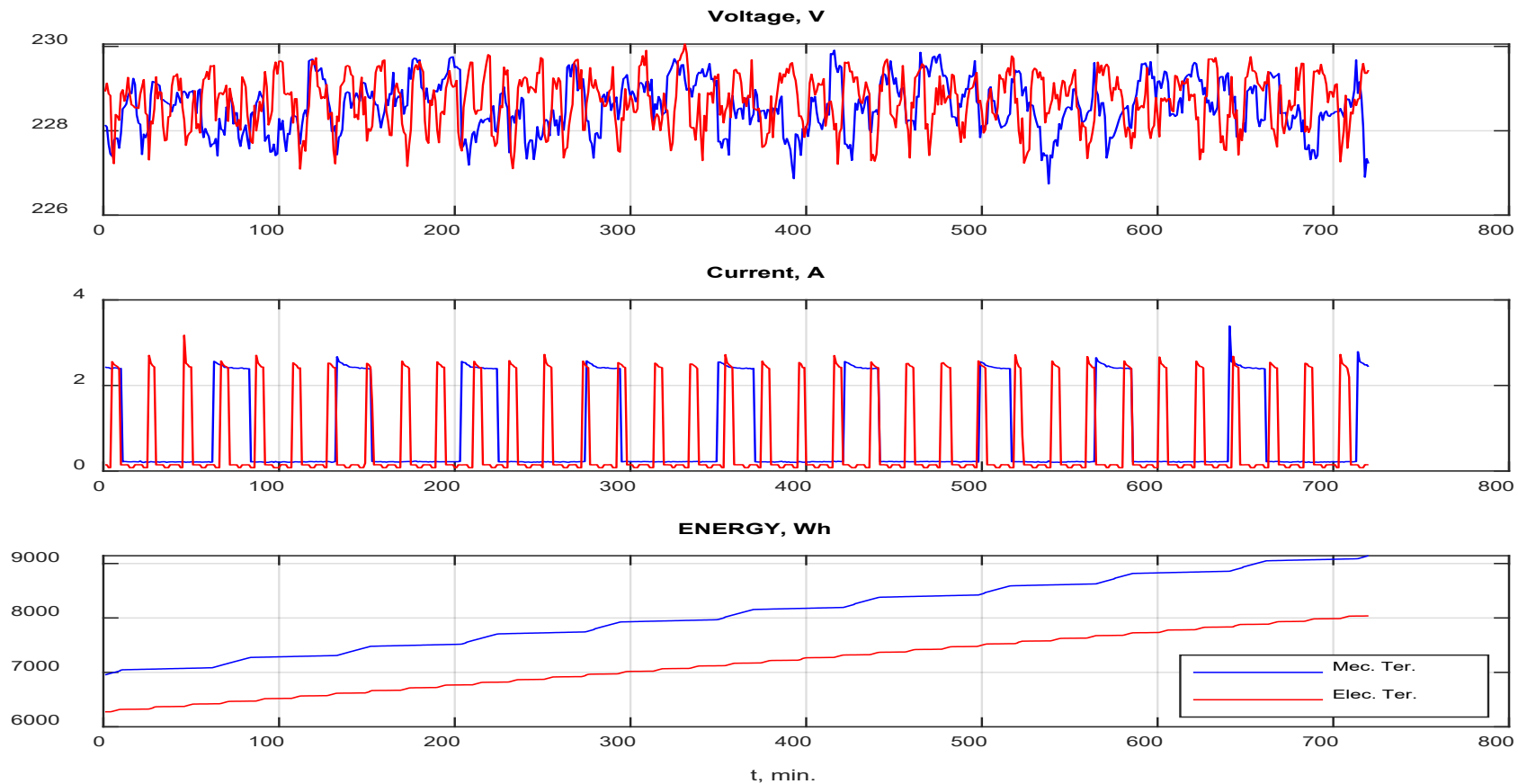
Figure 6. Connection points for measurements



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## 3. MEASUREMENTS

- ✓ In Figure 7, the electricity measurements from energy analyzer for both cases (mechanical and electronic thermostat cases) are given for 12 hours only.



## 3. MEASUREMENTS

- ✓ In Figure 8, the inner temperature measurements of the cabinet for both cases are given. The measurements are taken from the top, middle and bottom levels of the cabinet. It is clear, electronic thermostat can be tuned more sensitively and hence it responds to the temperature changes immediately.

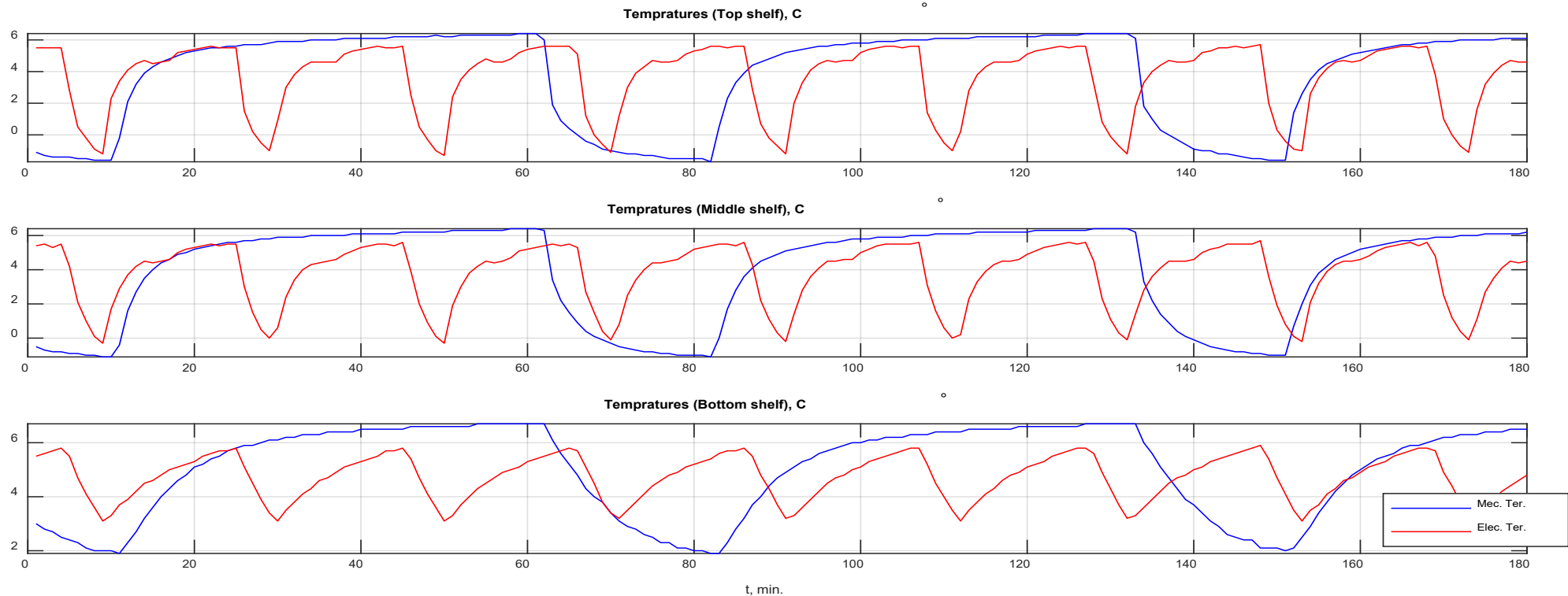


Figure 8. Cabinet inner temperature measurements for both cases. Measurements are done at the bottom, middle and top locations of the cabinet.

## 3. MEASUREMENTS

- ✓ The result of such an operation on the electricity consumption is seen clearly in Figure 7. For more clear & detailed graphics, same figure is given for 180 minutes only in Figure 9.

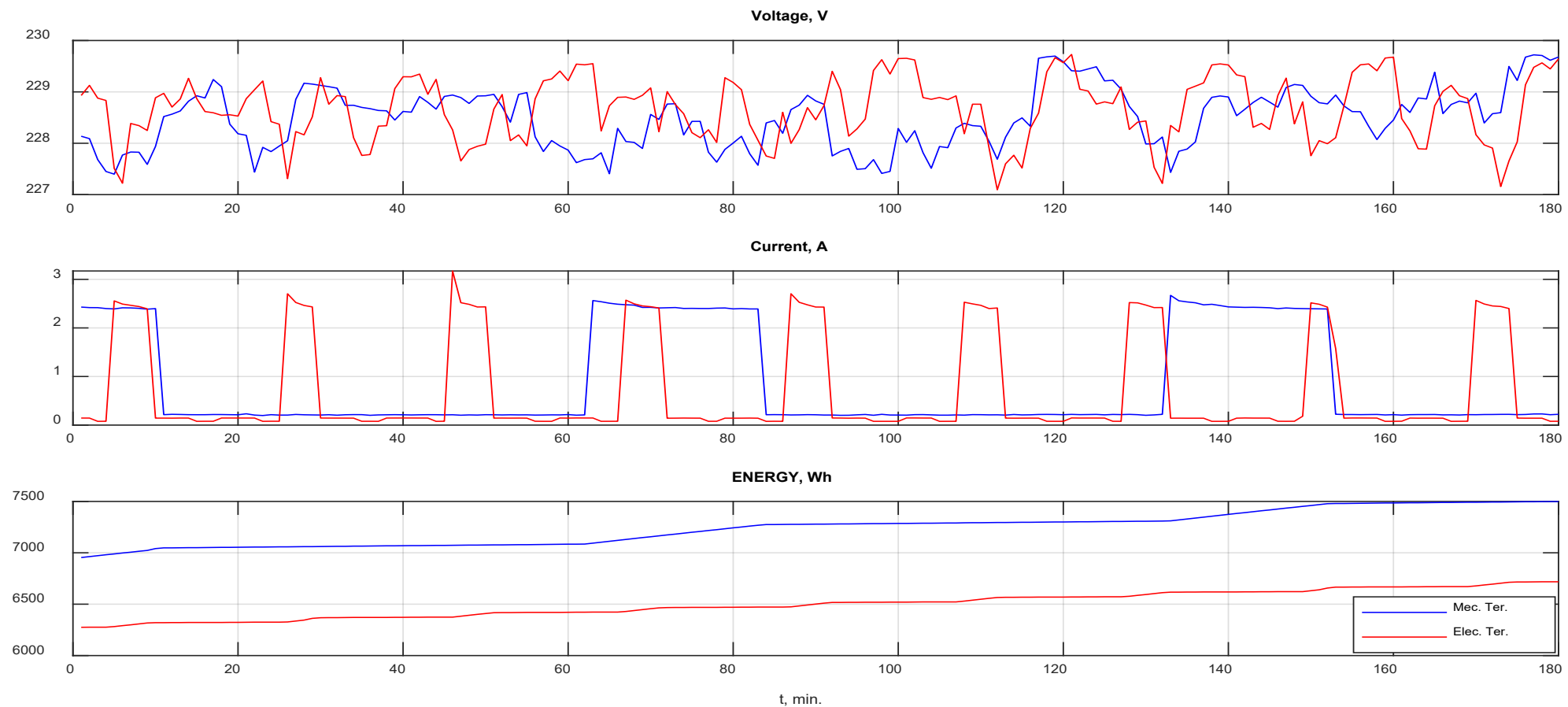


Figure 9. Electricity measurements for both Mechanical and Electronic thermostat cases (for 180 minutes).

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### 4. RESULTS & CONCLUSIONS

- ✓ The measurements shows that commercial refrigerator (beverage) cabinets using **electronic thermostats** consume less energy with shorter cycle times.
- ✓ It runs for 5 minutes and stays in thermostat mode for 15 minutes, completing a cycle in just 20 minutes.
- ✓ It consumes only 44 Wh of energy during this period.
- ✓ The cabinet using a **mechanical thermostat** consumes 192 Wh of energy in its 72-minutes cycle.
- ✓ This huge difference clearly shows that the electronic thermostat works more efficiently in terms of both electricity consumption and cooling performance.

#### 4. RESULTS & CONCLUSIONS

- ✓ The cabinet using an electronic thermostat completes its cooling cycle **72 times in a day** (24 hours). This means that the total daily **energy consumption is 3168 Wh.**
- ✓ The cabinet using a mechanical thermostat cooling cycles only **19 times** and **consumes a total of 3648 Wh of energy per day.**
- ✓ The ability of the electronic thermostat to cycle more frequently and perform the same function with less energy (**13.7% less energy**) provides a great advantage in terms of energy efficiency.