

## Part 1 - Demand Load Estimation

- My home is supplied by a three-phase system. The panel readings are approximately 219-220 V phase-to-neutral.
- Demand factors are selected from the IEC Load Assessment Method in the lecture slides: 0.80 for lighting, 0.60 for small-power loads, 0.70 for fixed appliances, and 0.80 for air-conditioning. These values are within the typical ranges given on the IEC example in the slides.
- For each load group, Connected Load = Load Value x Count, and Demand Load = Connected Load x Demand Factor in kW.
- In practice, the high-power loads are managed so that they are not all operated at the same time. Typically, one or two air conditioners, one water heater, and selected laundry loads are used while keeping the actual current within the 20A limit the local generator provides us.
- The home has 30 socket locations, 8 of which are double sockets.

Table 1 - Home Demand Load Estimation

| Category                    | Consumer                                              | Load Value (Single Unit) | Count              | Total Load                 | DF  | Demand Load |
|-----------------------------|-------------------------------------------------------|--------------------------|--------------------|----------------------------|-----|-------------|
| <b>LIGHTING AND SOCKETS</b> | General Ceiling LED Lighting                          | 250 W                    | 1                  | 0.25 kW                    | 0.8 | 0.200 kW    |
|                             | Yellow Ceiling Spotlights                             | 210 W                    | 1                  | 0.21 kW                    | 0.8 | 0.168 kW    |
|                             | Socket Outlets (30 locations, 8 being double-sockets) |                          | 30                 | Included in listed devices | 0.6 | Included    |
| <b>KITCHEN</b>              | Big Refrigerator (with Freezer)                       | 920 W                    | 1                  | 0.92 kW                    | 0.7 | 0.644 kW    |
|                             | Small Refrigerator                                    | 120 W                    | 1                  | 0.12 kW                    | 0.7 | 0.084 kW    |
|                             | Campomatic Microwave                                  | 1300 W                   | 1                  | 1.3 kW                     | 0.6 | 0.78 kW     |
|                             | Campomatic Air Fryer                                  | 1850 W                   | 2                  | 3.7 kW                     | 0.6 | 2.22 kW     |
|                             | Contact Grill (Seb)                                   | 1200 W                   | 1                  | 1.2 kW                     | 0.6 | 0.72 kW     |
|                             | Ninja Creami                                          | 800 W                    | 1                  | 0.8 kW                     | 0.6 | 0.48 kW     |
|                             | Blender                                               | 500 W                    | 1                  | 0.5 kW                     | 0.6 | 0.3 kW      |
|                             | Kitchen Vent                                          | 200 W                    | 1                  | 0.2 kW                     | 0.7 | 0.14 kW     |
|                             |                                                       |                          |                    |                            |     |             |
| <b>LAUNDRY AND CLEANING</b> | Campomatic Inverter Washing Machine                   | 2000 W                   | 1                  | 2 kW                       | 0.7 | 1.4 kW      |
|                             | Campomatic Heat Pump Dryer                            | 616 W                    | 1                  | 0.616 kW                   | 0.7 | 0.431 kW    |
|                             | Cordless Vacuum Cleaner                               | 450 W                    | 1                  | 0.45 kW                    | 0.6 | 0.27 kW     |
| <b>ELECTRICAL DEVICES</b>   | Gaming PC (Intel Core i7, RTX 2060, 16 GB RAM)        | 500 W                    | 1                  | 0.500 kW                   | 0.6 | 0.3 kW      |
|                             | PC Monitors (LG 120 Hz + MSI 144 Hz)                  | 80 W total               | 1 set (2 monitors) | 0.08 kW                    | 0.6 | 0.048 kW    |

| Category            | Consumer                                                           | Load Value (Single Unit) | Count             | Total Load | DF  | Demand Load |
|---------------------|--------------------------------------------------------------------|--------------------------|-------------------|------------|-----|-------------|
|                     | UPS (PC + LG Monitor, connected)                                   | 20 W                     | 1                 | 0.02 kW    | 0.6 | 0.012 kW    |
|                     | Televisions (StarSat and Skyworth)                                 | 150 W                    | 2                 | 0.3 kW     | 0.6 | 0.18 kW     |
|                     | MSI E13 Flip Evo Laptop                                            | 65 W                     | 1                 | 0.065 kW   | 0.6 | 0.039 kW    |
|                     | Charging Loads (iPhones, iPad, Apple Watch, Powerbank, IQOS cases) | 145 W total              | 1                 | 0.145 kW   | 0.6 | 0.087 kW    |
|                     | Internet Equipment (Fiber Optics + 3 Wi-Fi Routers)                | 45 W total               | 1 set (4 devices) | 0.045 kW   | 0.6 | 0.027 kW    |
|                     | Hair Dryer                                                         | 1800 W                   | 1                 | 1.8 kW     | 0.6 | 1.08 kW     |
|                     | Hair Straightener                                                  | 60 W                     | 1                 | 0.06 kW    | 0.6 | 0.036 kW    |
| <b>HEATING / AC</b> | Water Heaters                                                      | 2000 W                   | 2                 | 4.0 kW     | 0.7 | 2.8 kW      |
|                     | Midea Air Conditioners                                             | 1200 W rated             | 2                 | 2.4 kW     | 0.8 | 1.92 kW     |
|                     | Beko Air Conditioner                                               | 1700 W                   | 1                 | 1.7 kW     | 0.8 | 1.36 kW     |
|                     | Water Pump (domestic)                                              | 1100 W                   | 1                 | 1.1 kW     | 0.7 | 0.77 kW     |

**Total connected load = 24.481 kW (excluding the central 3-phase AC because only its starting current is known).**

**Estimated demand load = 16.196 kW, approx. 16.2 kW.**

The central 3-phase air conditioner is not used. Its branch MCBs remain OFF and its observed starting current is approximately 60 A.

## Part 2 - Monthly Electrical Bill Estimation

- The estimate is for a representative summer month (30 days) at a rate of 0.50 USD/kWh.
- The refrigerators stay powered 24 h/day, but the compressors cycle OFF after the required temperature is reached as discussed in class today.
- The two Midea air conditioners are ON about 12 h/day each. The Beko AC unit is ON about 15 h/day.

Table 2 - Estimated Monthly Electrical Energy Consumption

| Category        | Consumer                        | Usage Used                  | kWh / Month |
|-----------------|---------------------------------|-----------------------------|-------------|
| <b>LIGHTING</b> | General Ceiling LED Lighting    | 250 W x 16 h/day            | 120         |
|                 | Yellow Ceiling Spotlights       | 210 W x 4 h/month           | 0.84        |
| <b>KITCHEN</b>  | Big Refrigerator (with Freezer) | 920 W x 24 h/day x 25% duty | 165.6       |
|                 | Small Refrigerator              | 120 W x 24 h/day x 35% duty | 30.24       |
|                 | Campomatic Microwave            | 1300 W x 20 min/day         | 13.00       |
|                 | Campomatic Air Fryers (2x)      | 3.70 kW x 2 h/week          | 32.04       |

| Category                           | Consumer                                                 | Usage Used                                                     | kWh / Month |
|------------------------------------|----------------------------------------------------------|----------------------------------------------------------------|-------------|
|                                    | Contact Grill (Seb) + Ninja Creami + Blender             | Combined estimate for rare use                                 | 2           |
|                                    | Kitchen Vent Hood / Extractor                            | 200 W x 1 h/day                                                | 6           |
| <b>LAUNDRY AND CLEANING</b>        | Campomatic Inverter Washing Machine                      | ~0.8 kWh/cycle x 30 cycles                                     | 24          |
|                                    | Campomatic Heat Pump Dryer                               | 616 W x 1.5 h/day                                              | 27.72       |
|                                    | Cordless Vacuum Cleaner                                  | 65 Wh battery charge/day                                       | 1.95        |
| <b>ELECTRONICS / PERSONAL CARE</b> | Gaming PC (Intel Core i7, RTX 2060, 16 GB RAM)           | 150 W avg x 16 h + 5 W sleep x 8 h/day                         | 73.20       |
|                                    | PC Monitors + UPS                                        | Monitor use + UPS losses                                       | 49.68       |
|                                    | Televisions                                              | Assume around 60 kWh (both used daily for around 8 hours each) | 60          |
|                                    | MSI Laptop + Phone/Tablet/Watch/Powerbank/IQ OS Charging | Assume daily charging of all devices                           | 10          |
|                                    | Fiber Optics + 3 Wi-Fi Routers                           | 45 W x 24 h/day                                                | 32.40       |
|                                    | Hair Dryer + Hair Straightener                           | Rare use                                                       | 10          |
| <b>HEATING / AC</b>                | Midea Air Conditioners (2 units)                         | 2 x 766 W x 12 h/day x 70% duty                                | 386.06      |
|                                    | Beko Air Conditioner                                     | 1121 W x 15 h/day x 70% duty                                   | 353.12      |
|                                    | Water Heaters                                            | 2 kW x 1 h/day + 2 kW x 2.5 h/day                              | 210         |
|                                    | Water Pump                                               | 1.1 kW x 0.3 h/day                                             | 9.9         |

**Total estimated monthly energy = 1,617.75 kWh.**

**Estimated monthly electrical bill = 1,617.75 kWh x 0.50 USD/kWh = \$808.88.**

Our local generator allocation is 20 A for a fixed monthly fee of about \$800, regardless of energy consumption. The hypothetical energy-based estimate above (\$808.88) is therefore close to the actual fixed monthly charge.

## References

- EECE 475, Lecture Slides (Chapter 2)
- IEC demand-factor ranges (Lecture Slide 18)
- User manuals/nameplates for most of the electrical devices
- Home Distribution Panel-board

## Appendix – Equipment and Panel Pictures

**Laptop Charger Nameplate**



**Vacuum Cleaner Nameplate**



**Home Distribution Panel-board - Three-phase Supply**



The main device is a four-pole MCB for L1, L2, L3 and neutral. The three meters show approximately 219-220 V phase-to-neutral.

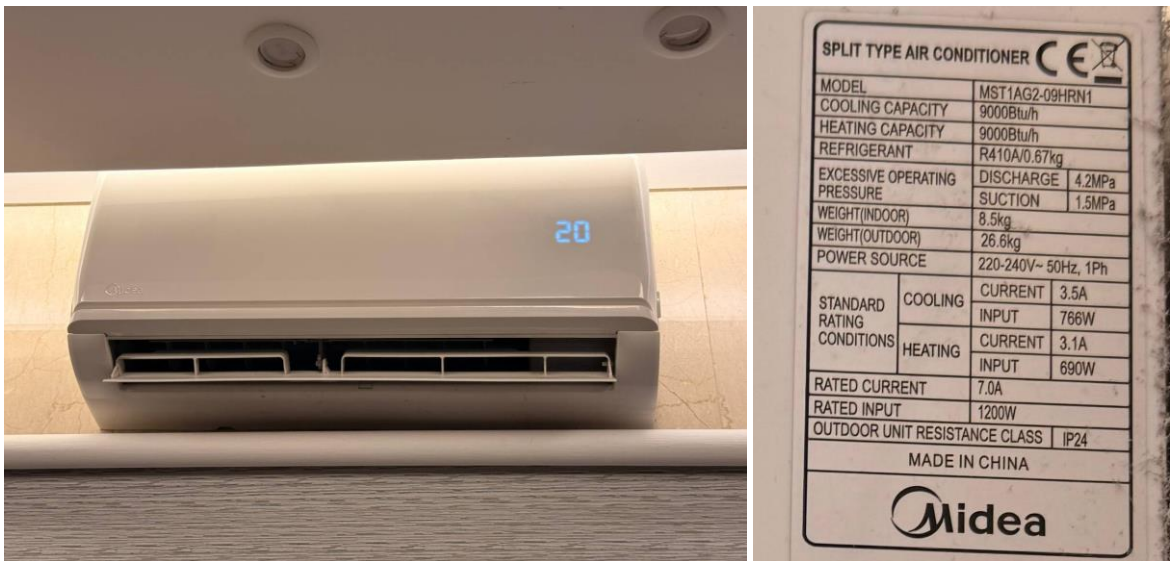
**Lighting/Kitchen and Central Air Conditioning MCBs**

The central-air-conditioning branch MCBs are OFF because the old central 3-phase air conditioner is not used. Its observed starting current is approximately 60 A, which exceeds the practical household generator allocation.

### Campomatic Air Conditioner



### Midea Air Conditioner



### Beko Split Air Conditioner

