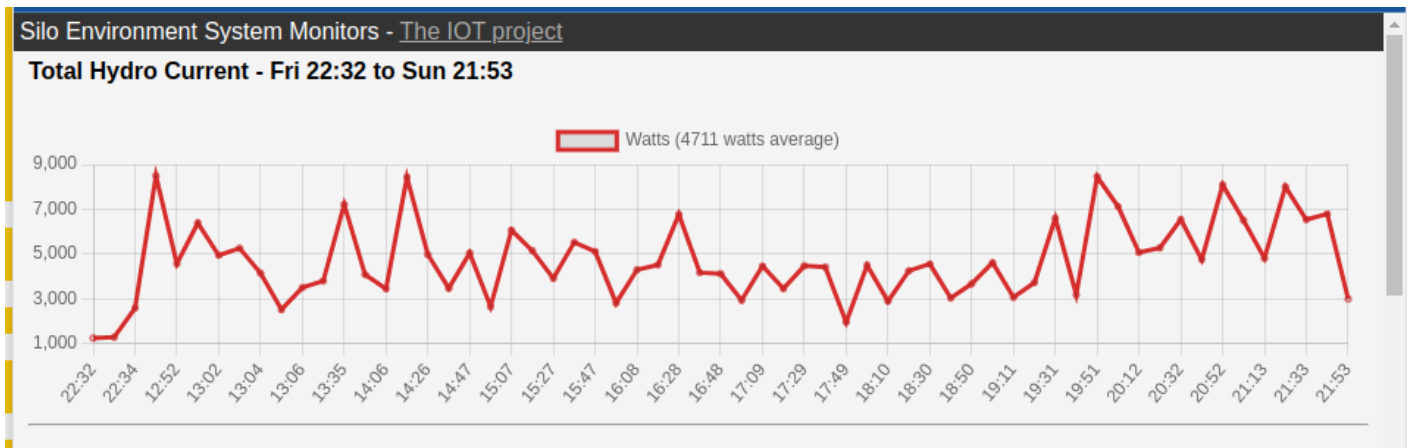


# Home Power Consumption Monitoring

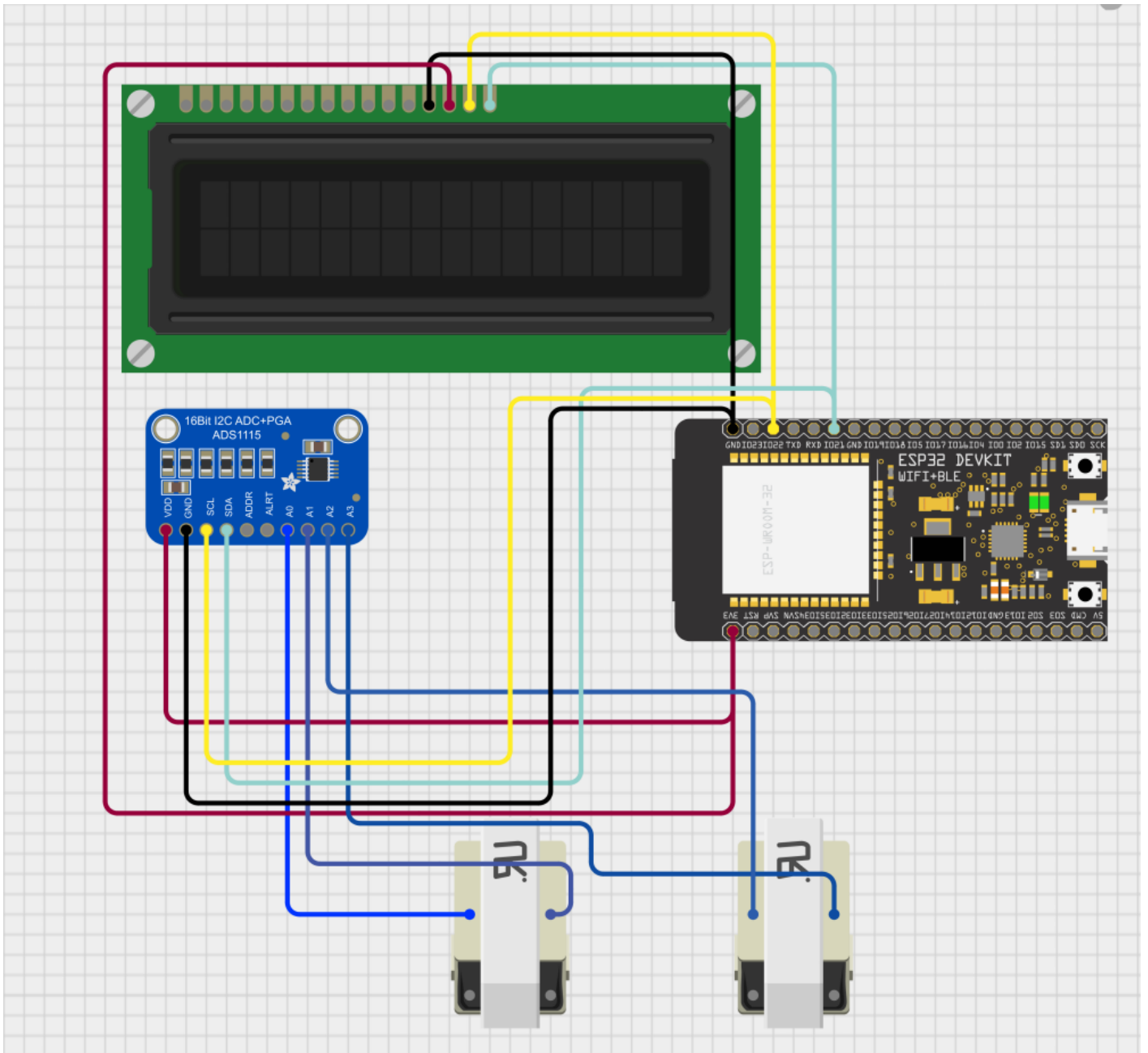
For this project the goal is to know exactly how much current is being used for the entire property. To collect this data I placed 2 SCT013 non-invasive split core current transformers around the phase 1 and 2 wires in the main electrical panel. Using some simple math this can convert the small voltage in the transformers into an accurate current reading.



## Components (total cost \$20 CAD):

- ESP32 WROOM (\$5 CAD) - <https://www.aliexpress.com/item/4000471022528.html>
- 2 x SCT013 split core transducers (\$8 CAD) - <https://www.aliexpress.com/item/1005006318596840.html>
- 16 Bit I2C ADS1115 Module (\$3 CAD) - <https://www.aliexpress.com/item/32817162654.html>
- OLED SSD1306 (\$1.50 CAD) - <https://www.aliexpress.com/item/32643950109.html>
- 3d printer filament (\$1 CAD)

## Wiring Diagram:



A clamp meter was used to confirm the calculated values were valid for a wide range of current (1 amp up to 60)



Relay unit mounted on the wall:



And the code to make it all happen:

```
#include <SPI.h>
#include <WiFi.h>
#include <HTTPClient.h>
#include <Wire.h>
```

```
#include <Adafruit_GFX.h>
#include <Adafruit_SSD1306.h>
#include <Adafruit_ADS1X15.h>
#include <EEPROM.h>
#include "splashscreenbitmap.h" // just make it look fun on bootup

int activeConnection = 1;

// network 1
const String ssid1 = "xxx";
const String password1 = "xxxxxxx";

// network 2
const String ssid2 = "xxx";
const String password2 = "xxxxx";

const String heartbeatUrl = "https://xxx.xxx.com/silopower/heartbeat.php";
const String currentUrl = "https://xxx.xxx.com/silopower/set_hydro_current.php?data=";

#define EEPROM_SIZE 4
int eepromPingsAddress = 0;
float totalServerPings = 0;
int eepromFailedPingsAddress = 1;
float totalServerPingFails = 0;
int eepromActiveConnection = 1;

#define SCREEN_WIDTH 128 // OLED display width, in pixels
#define SCREEN_HEIGHT 64 // OLED display height, in pixels
#define LOGO_HEIGHT 128
#define LOGO_WIDTH 64

// Declaration for an SSD1306 display connected to I2C (SDA, SCL pins)
#define OLED_RESET - 1 // Reset pin # (or -1 if sharing Arduino reset pin)
Adafruit_SSD1306 display(SCREEN_WIDTH, SCREEN_HEIGHT, & Wire, OLED_RESET);

Adafruit_ADS1115 ads;

long secondsOfHour = 0;

const int pulseRate = 1000; // loop runs once per second
```

```
const int serverSendInterval = 10; // 10 minutes between sending a pressure update to the server
const int samplesPerReading = 12 * serverSendInterval; // reading current takes 5 seconds so 60 / 5 = 12

int loopCount = 0;

String payload = "";
int httpCode = 0;
bool wifiConnected = false;
bool wifiPaused = false;
int wifiPausedTick = 0;
bool wifiSleeping = false;
bool debug = false; // when true server does not update
bool serverFailed = false;
int wifiConnectionAttempts = 0;

float basePressureVoltage = 0.46;
float totalledAveragePressure = 0;
float averagePressure = 0;

const float FACTOR = 9;

const int secondsPerHour = 3600; // set to 60 for debugging

HTTPClient http;

void setup() {

  Serial.begin(115200);

  if (!display.begin(SSD1306_SWITCHCAPVCC, 0x3C)) {
    Serial.println(F("SSD1306 allocation failed"));
    for (;;) // Don't proceed, loop forever
  }

  if (!ads.begin()) {
    Serial.println("Failed to initialize ADS.");
    while (1);
  }
```

```
// ads.setGain(GAIN_FOUR);

display.clearDisplay();
display.drawBitmap(0, 0, epd_bitmap_annie, 128, 64, 1);
display.display();
delay(3000);

EEPROM.begin(EEPROM_SIZE);

activeConnection = EEPROM.read(eepromActiveConnection);

Serial.print("eepromActiveConnection :");
Serial.println(activeConnection);

if (isnan(activeConnection)) {
    activeConnection = 1;
}

if (activeConnection == 0) {
    activeConnection = 1;
}

if (activeConnection > 2) {
    activeConnection = 2;
}

Serial.print("activeConnection: ");
Serial.println(activeConnection);

float pingData = EEPROM.readFloat(eepromPingsAddress);
if (isnan(pingData)) {
    pingData = 0;
}
totalServerPings = pingData;
EEPROM.end();
EEPROM.begin(EEPROM_SIZE);
float pingFailData = EEPROM.readFloat(eepromFailedPingsAddress);
if (isnan(pingFailData)) {
    pingFailData = 0;
}
```

```
}
totalServerPingFails = pingFailData;
EEPROM.end();

if (!connectToWiFi()) {
    delay(2000);
    WiFi.disconnect();
    delay(1000);
    if (activeConnection == 1) {
        activeConnection = 2;
    } else {
        activeConnection = 1;
    }
    connectToWiFi();
}

delay(2000); // Pause for 2 seconds

}

void loop() {

    secondsOfHour++;

    // after 24 hours reset this integer
    if (secondsOfHour > 86400) {
        secondsOfHour = 1;
        ESP.restart();
    }

    float amps = getAmps();
    float watts = amps * 120;

    display.clearDisplay();
    display.setTextSize(2);
    display.setTextColor(WHITE);
    display.setCursor(0, 0);
    display.print("W:");
    display.println(watts, 0);
    display.print("A:");
```

```
display.println(amps, 0);
display.setTextSize(1);
display.println("internet:");
display.println(wl_status_to_string(WiFi.status()));
display.display();

////////////////////
// SERVER RELAY

if (!debug && (loopCount >= samplesPerReading) || serverFailed) {

    loopCount = 0;
    totalledAveragePressure = 0;

    setWifiSleepMode(false);

    delay(2000);

    // do a heartbeat check to see if we are online...
    http.begin(heartbeatUrl);
    httpCode = http.GET();
    if (!httpCode > 0) {
        // wifi may not be alive yet so wait 3 seconds
        delay(3000);
    }

    String recordedWatts = String(watts, 1);

    recordedWatts.trim();

    loopCount = 0;

    http.begin(currentUrl + recordedWatts);
    httpCode = http.GET();
    if (httpCode > 0) {
        payload = http.getString();
        Serial.println("HTTP Response: " + payload);
        recordPingSuccess();
    } else {
        recordPingFailure();
    }
}
```

```
}  
http.end();  
  
setWifiSleepMode(true);  
}  
  
loopCount++;  
  
}  
  
bool connectToWiFi() {  
  
    String activeSsid = "";  
    String activePassword = "";  
  
    if (activeConnection == 1) {  
        activeSsid = ssid1;  
        activePassword = password1;  
    } else if (activeConnection == 2) {  
        activeSsid = ssid2;  
        activePassword = password2;  
    }  
  
    Serial.print("Connecting to WiFi: ");  
    Serial.println(activeSsid);  
  
    WiFi.begin(activeSsid, activePassword);  
  
    while (WiFi.status() != WL_CONNECTED && wifiConnectionAttempts < 20) {  
        delay(500);  
        Serial.print(".");  
        wifiConnectionAttempts++;  
    }  
  
    wifiConnectionAttempts = 0;  
  
    if (WiFi.status() == WL_CONNECTED) {  
        Serial.println("\nConnected to WiFi");  
        Serial.print("IP Address: ");  
        Serial.println(WiFi.localIP());  
    }  
}
```

```

wifiConnected = true;

EEPROM.begin(EEPROM_SIZE);
EEPROM.write(eepromActiveConnection, activeConnection);
EEPROM.commit();
EEPROM.end();

Serial.print("set activeConnection to : ");
Serial.println(activeConnection);

return true;

} else {
    Serial.print("Connection to ");
    Serial.print(activeSsid);
    Serial.println(" failed. Trying alternative");
    return false;
}
}

/**
 * set wifi sleep mode between data relays to conserve energy
 * @param sleepMode - if true set wifi card to sleep to conserve energy
 */
void setWifiSleepMode(bool sleepMode) {

    wifiSleeping = sleepMode;

    if (sleepMode) {
        WiFi.disconnect();
        WiFi.setSleep(true);
        delay(1000);
        Serial.print("sleep wifi status: ");
        Serial.println(wl_status_to_string(WiFi.status()));
    } else {
        WiFi.setSleep(false);
        WiFi.reconnect();
        delay(1000);
        Serial.print("awaken wifi status: ");
        Serial.println(wl_status_to_string(WiFi.status()));
    }
}

```

```

// Check if the connection is still active. if not trigger wait for it to come back online
if (WiFi.status() != WL_CONNECTED && !wifiPaused) {
    Serial.println("Connection lost. Attempting to reconnect in 1 minute ...");
    WiFi.disconnect();
    wifiPaused = true;
    wifiConnected = false;
    connectToWiFi();
}
}
}

/**
 * record server ping success in long term memory
 */
void recordPingSuccess() {
    totalServerPings++;
    EEPROM.begin(EEPROM_SIZE);
    EEPROM.writeFloat(eepromPingsAddress, totalServerPings);
    EEPROM.commit();
    EEPROM.end();
    wifiConnected = true;
    serverFailed = false;
}

/**
 * record server ping fails in long term memory
 */
void recordPingFailure() {
    totalServerPingFails++;
    EEPROM.begin(EEPROM_SIZE);
    EEPROM.writeFloat(eepromFailedPingsAddress, totalServerPingFails);
    EEPROM.commit();
    EEPROM.end();
    wifiConnected = false;
    serverFailed = true;
}

/**
 * ESP32 wifi card statuses
 * @param status

```

```
* @return string
*/
String wl_status_to_string(wl_status_t status) {
```

```
String response = "";
```

```
switch (status) {
```

```
case WL_NO_SHIELD:
```

```
    response = "WL_NO_SHIELD";
```

```
    break;
```

```
case WL_IDLE_STATUS:
```

```
    response = "WL_IDLE_STATUS";
```

```
    break;
```

```
case WL_NO_SSID_AVAIL:
```

```
    response = "WL_NO_SSID_AVAIL";
```

```
    break;
```

```
case WL_SCAN_COMPLETED:
```

```
    response = "WL_SCAN_COMPLETED";
```

```
    break;
```

```
case WL_CONNECTED:
```

```
    response = "WL_CONNECTED";
```

```
    break;
```

```
case WL_CONNECT_FAILED:
```

```
    response = "WL_CONNECT_FAILED";
```

```
    break;
```

```
case WL_CONNECTION_LOST:
```

```
    response = "WL_CONNECTION_LOST";
```

```
    break;
```

```
case WL_DISCONNECTED:
```

```
    response = "WL_DISCONNECTED";
```

```
    break;
```

```
}
```

```
return response;
```

```
}
```

```
/**
```

```
* Get the current in amps coming from the hall sensor
```

```
* @return float
```

```

*/
float getAmps() {

    float sensor1Reading;
    float sensor2Reading;
    float amps1 = 0;
    float amps2 = 0;

    float combinedReading;
    float sum = 0;
    long time_check = millis();
    int counter = 0;

    while (millis() - time_check < 5000) {

        sensor1Reading = ads.readADC_Differential_0_1();
        sensor2Reading = ads.readADC_Differential_2_3();

        // ac current flows in 2 directions so grab the flow in each direction
        if(sensor1Reading < 0) {
            sensor1Reading = sensor1Reading * -1;
        }

        if(sensor2Reading < 0) {
            sensor2Reading = sensor2Reading * -1;
        }

        if(sensor1Reading < 2) {
            sensor1Reading = 0;
        }

        if(sensor2Reading < 2) {
            sensor2Reading = 0;
        }

        amps1 += sensor1Reading;
        amps2 += sensor2Reading;

        combinedReading = amps1 + amps2;
    }
}

```

```
    counter = counter + 1;
}

float reading = (combinedReading / counter);

float averageAmps1 = (amps1 / counter);
float averageAmps2 = (amps2 / counter);

// some adjustments for variations in readings
float divider = .155;
averageAmps1 = averageAmps1 * divider + (averageAmps1 * 0.015);
averageAmps2 = averageAmps2 * divider + (averageAmps2 * 0.015);

return averageAmps1 + averageAmps2;

}
```

---

Revision #19

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