

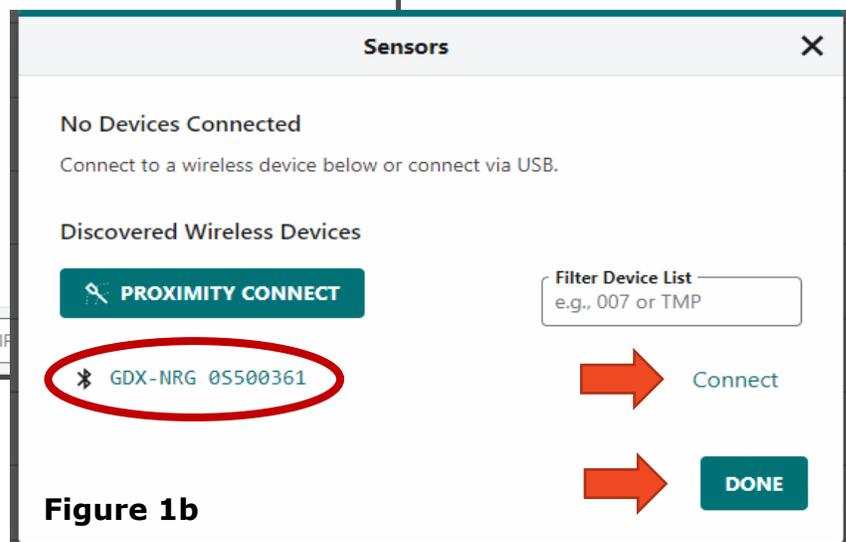
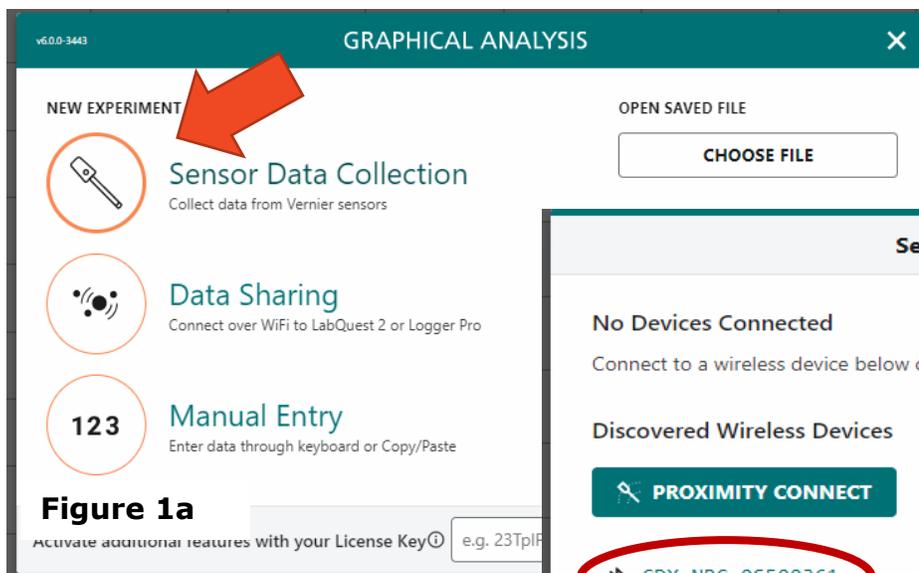
How to Measure Energy Output using the Go Direct Energy Sensor and the Vernier Graphical Analysis Program

Download software at: <https://www.vernier.com/downloads/graphical-analysis/>

Note: These instructions assume a similar setup to the Kansas KidWind Challenge.

1. Upon opening software:

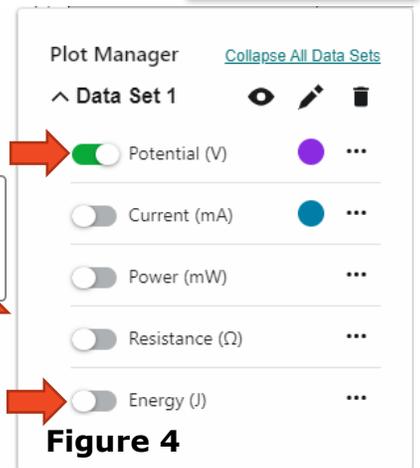
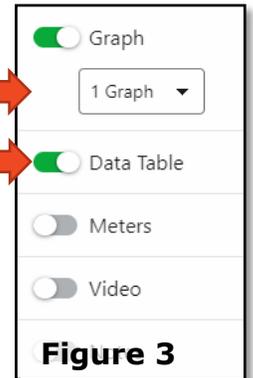
- Wired: If device is plugged in, it should automatically open to the correct energy-measuring settings (two graphs showing potential (V) and current (mA)). Go to Step 2.
- Wireless/Bluetooth: It should first open to a window where you can click on "Sensor Data Collection" (see Figure 1a below). If not, click on the "sensor setup" icon (🔑) in the lower right-hand corner of the window.
 - The program will automatically find energy sensors that are turned on (see red circle in Figure 1b below) – check the sensor number to make sure you are connecting to the correct one
 - Click "Connect" and "Done" as shown in Figure 1b below.



2. Make sure the toggle button on the side of the sensor is set to "internal 30-ohm (Ω) load" (see Figure 2).



- Using the view options icon () in the top-right of the screen, choose to display "1 Graph" and the "Data Table" (see Figure 3).
- Click on the vertical y-axis of the graph (it likely says "Potential (V).") Turn off "Potential (V)" and turn on "Energy (J)." Energy output in Joules is what is measured for the competition (see Figure 4 below).
- On the data table on the right side of screen, scroll all the way over so the "Energy (J)" column is displayed (see Figure 5 below).
- Once the turbine is turning at full-speed and the team gives the go-ahead, click "Collect," at the top of the screen.
- Each test run will automatically end after 30 seconds. The total energy output (Joules) will be the last row displayed in the data table, so you will need to scroll down (see Figure 5 below, row 300 or 301). The sensor collects data every 1/10 of a second (30 seconds \times 10 collections per second = 300 rows of data). You will record this value as the turbine energy output.
- In the data table (see Figure 5), occasionally double-check the "Resistance (Ω)" column to make sure the switch on the device has not been turned off.
- If you'd like to save each team's file, you can do that by clicking on "Untitled" in the top left and then "Save As."
- Once the file is saved, click on the file name in the upper-left corner of the screen and choose "New Experiment" to reset and create a file for the next team.
- If you encounter any glitches, restart the software and the sensor.



	Data Set 1				...
	(mA) ...	Power (mW) ...	Resistance (Ω) ...	Energy (J) ...	
296	2.8	0.2	30	0.28	
297	-0.3	0.0	30	0.28	
298	-28.7	25.0	30	0.28	
299	-24.9	18.8	30	0.29	
300	1.4	0.1	30	0.29	
301	1.2	0.0	30	0.29	
302					