

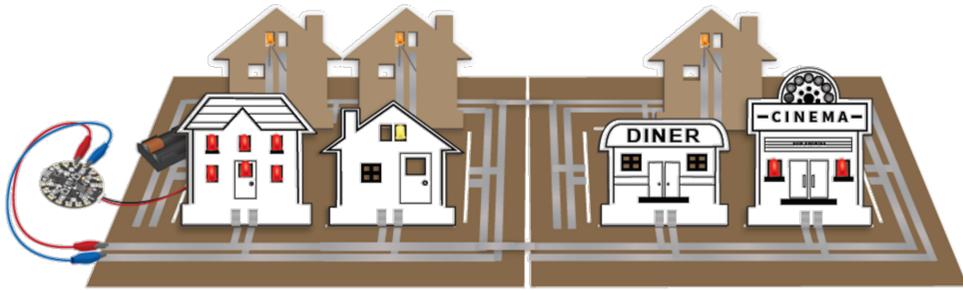
Securing the energy delivery system of the future requires an engaged and informed society

MAKING CONNECTIONS

- Creating connections between important new ideas and familiar concepts
- Linking researchers, educators, students, families

CONNECTIONS INCREASE UNDERSTANDING

- Sensors and smart devices connect coding and the physical world



- Encryption helps keep data safe

Smart Switches

Smart switches can be found in many places throughout the electric grid. Protection relays protect the power grid when an outage is detected. The device is designed to break the circuit if part of the grid is damaged. For example, if a tree falls on a power line a relay will quickly detect a fault, which in turn flips a switch to stop power from flowing down the fallen line. Once the fault is repaired, the relay can switch the power line back to normal operation.

Relay Breakout Board

The TPOG Education Relay Breakout Board is a printed circuit board (PCB) that models a simplified power system for a small neighborhood. When sufficient power is supplied to the solar panels, the orange indicator is on, and the solar panels produce enough electricity to power the relay switches to allow the homes and the yellow indicator to be powered. The yellow indicator is on.

Compare the traces on the PCB to the diagram on the previous page to see how the relay is managed by the power source.

Assembling the breakout board

- Push the legs of the red LEDs through the connecting pin holes near the houses. Insert the longer (positive) leg through the center hole and the shorter (negative) leg through the square hole at each house.
- Insert a yellow LED to indicate when the battery is providing electricity.
- Push the leg through and bend away from each other. Use clear tape or solder to hold in place.
- Insert the relay into the PCB from the back. Line the pins up with the holes and without bending the pins that move when the magnet is on or are inside the relay box.
- Put two batteries in the battery holder. The printed sides of the battery connecting pin holes. Be sure the positive pin is in the positive through hole.
- The battery power should light the yellow battery indicator LED and the three red LEDs in the houses. Depending on the type of solar panel and the sun conditions you may need to connect more than one solar panel to generate enough electricity to power the electromagnet and the three houses. You may be able to hear the relay click when the electromagnet pins the contacts. If you hear the click and the orange solar indicator lights, the solar panel is producing. The solar panel produces best in bright sunlight. You may need to add another solar panel if conditions are not some enough.

- The self-healing grid uses real-time data to detect outages.
- Smart distribution systems minimize the number of customers affected in an outage.

ENCOURAGING WONDER

- Minecraft: World of Pipelines World of Power
- Energy Science Kits
- Community events
- Saturday learning
- Camps



#2 DESIGN A POWER PARK: SMART CIRCUITS

A creative and innovative way for young engineers to explore programming

Import library: digitalWrite, delay, pinMode

Language: C++

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