# MEDIA FIELDS

### How to Hack the Grid

Andrea Polli

The following manifesto is adapted from my book, *Hack the Grid*, forthcoming from the Carnegie Museum of Art. The book expands upon these ideas through a series of case studies of energy-aware public works.

Welcome to *Hack the Grid*, a book and movement about hacking—not in the scary, destructive sense (we're not talking about cyberwarfare here), but instead using the original definition of "hacking": to make your own. Our goal throughout *Hack the Grid* is for you to understand more about the energy you consume, to "make it your own" by experimenting with energy-related technologies and ideas, and to be able to make more informed choices and advocate for the kind of energy you want in your homes and communities. Let's begin . . .

1. Learn as much as possible about how energy systems work. We plug our devices into the wall and power magically becomes available. We don't think about where that power is coming from or where it is made. We are sure it will always be there, almost as much as we know the sun will rise every day. But the process of getting power to that plug involves millions of choices: material choices regarding wiring, fasteners, shielding, and coatings; structural choices about where and how those wires move through space to distribute the energy; design choices, from where a plug is located to how the entire system is configured and how it can best be monitored and repaired. Most of these choices involve government regulation, and over the years these regulations and requirements have become more and more layered. These regulations are designed to keep us safe from scary things like fire and electrocution, but what about less immediate dangers? Shouldn't we also look at the safety of our air and water over longer time spans? It's not an easy problem, and we need your brainpower—and that of everyone who consumes energy—to solve it.

### 2. Know how much energy you consume and its environmental impact.

We obsess over every calorie we consume, even separating "good" calories from "bad" calories. We also obsess over burning our biological fuel: we have apps that count every step we take, we obtain readouts of our heart rate, and we examine the most efficient way to keep our bodies healthy. Why don't we do the same with our energy consumption? The environmental impacts of the energetic processes needed to move us around and to power our homes and devices affect our lives and our health through the air we breathe, the water we drink, and the food we eat. In many ways, the impacts of our energy consumption have a greater effect on us than the calories we consume and burn.

## 3. Demand that energy providers tell you the source of the energy you purchase.

Labels, labels, labels: they're everywhere. At the supermarket we see not only a list of ingredients but a table indicating amounts of sugar, fat, salt, and specific vitamins and minerals. Fast food restaurants list calorie counts next to menu items. Why don't energy providers give you similar information? Not all energy sources are the same. Some sources come from our backyards; others are transported thousands of miles. Shouldn't you as a consumer of energy know where that energy is coming from? What process creates that energy? Is the energy from a coal- or gas-fired power plant? Or is it wind or solar power, or even hydropower from a dam? According to the *Washington* Post, in 2016, 34 percent of US power was generated from natural gas, 30 percent from coal, 20 percent from nuclear, 7 percent from hydro, 6 percent from wind, 1 percent from solar, and under 1 percent from oil. These percentages vary widely by region. Shouldn't you be able to decide the kind of energy you want to buy just like you decide what kind of food you put in your body?

4. Find out the amount and kind of energy that is used to manufacture and transport the products you consume. Look around and count the number of manufactured objects around you right now. Now, pick one and think about what it took to make that one object. Think about every material, where it may have come from before it reached you: a farm, a mine, a chemical production plant. It's overwhelming to imagine all that data, but we use digital tools that manage that level of data every millisecond. Images, texts, and sound files zip through our social media on our laptops and phones, while our thoughts and ideas are broadcast around the world faster than we can come up with new ones. Digital tools and robotics are already managing the manufacture, flow, and purchase of goods across the globe. Let's dip our toe into that data stream and see how it feels to know where our money goes.

### 5. Learn to create a basic electric circuit, to use a multimeter, and to read a circuit diagram.

Now we're getting down to the nitty-gritty. When we talk about understanding how energy systems work, we're talking about basics. How do you get energy from one place to another? How does it transform into something useful like light? Understanding this is not intuitive because energy is invisible. At worst, we see or smell the impacts of energy production and consumption as black smoke or the odor of oil or gas. But otherwise, our senses don't perceive any trace of the charge. As human primates, we understand the world through our bodies: we need to touch things with our hands, manipulating stuff in the real world with the use of our opposable thumbs. Really understanding the basics of what makes up energy means rolling up your sleeves and twisting wires together.

#### 6. Learn to solder.

Wire nuts work great, but there's a problem of scale. If you've ever seen an early computer, you know what I mean. The gathering and transmission of data in digital form, even at a very basic level, has gotten smaller—a lot smaller. The good news is that it often takes less energy to transmit data through tiny circuits and less mined material is needed for each component. The bad news is you're going to need a magnifying glass and soldering iron and to get into some microprocessing.

#### 7. Learn to write computer programs.

You're moving the data around, but just like what's behind that power plug, it's invisible. You have to get it out of that microprocessor and onto a screen, and that's not trivial. From twisting wires and soldering you've got a body memory of how things are moving around. You have felt the materials—nothing too complicated, just a conductive metal and insulating plastic—so you know that this is something real, physical. You may not build the computer you're using to program this data (or maybe you have), but you've already got a sense of what it would take, so you're going virtual. Programming is the next step because it gives you the basics of what's behind all the apps, websites, and social media you use. The next time you're on your social media platform of choice, you might start to think about all the choices that other people made to create that experience for you, and other choices they could have made. Just like the layers of regulation that have gotten us to a complex energy production and consumption system, our information production and transmission system has become layered with choices made decades ago. Were these the best choices? The only way to answer that question is to learn what the choices have been and what other possibilities there may be.

## 8. Learn how to harvest energy from the sun, the wind, the earth, and your body.

You've hacked sensors, microcontrollers, laptops, and smartphones. You've moved energy around all these devices, but you still haven't connected what you are doing with the source of energy. Luckily, your devices likely don't need a lot of energy. You might charge up your smartphone as you bike to work. You might find (or build, now that you know how to solder) a small wind turbine or solar panel; you might make an energy-producing floor and have a dance party. The possibilities are endless. You can start small and become your own "nano-grid."

#### 9. Let the "smart" grid make you smarter.

If you use electricity from a meter, your energy is probably already on a "smart" grid. Didn't know that? Didn't even know what a smart grid is? Don't feel bad. Most people don't. A smart grid exploits two-way digital communication—the provider sends power and you send data back about how much power you use—to detect and react to local changes in usage. Two-way metering technology can even turn individual appliances in your house on and off according to demand and energy prices. The technology helps your energy provider avoid blackouts by monitoring what's being consumed in more detail than has ever been possible. But since detailed data about your energy consumption is being collected and transmitted, shouldn't it be available to you? If you could access it, how might you understand more about your energy usage and make smarter energy choices? Shouldn't you be able to share this data with others if you choose? Individual households and communities sharing data about best practices open potential to reduce energy consumption, lowering costs without reducing quality of life.

10. Don't be a passive consumer of technology or electronic media. Something has changed in you. You don't see the world in the same way. Those layers of complexity have been peeled back and you're more confident. You look at a power line, and you know where that energy came from and where it's going. Suddenly that latest tweet from a reality show TV star doesn't seem so important. The political tweets do though, especially the ones in your local community. You start to follow your state and local legislators, and that new proposed building code suddenly has a lot more meaning. You get the big picture and you're getting involved.

### **11.** Understand that your life is inextricably intertwined with your use of energy in all forms.

This is the crux of *Hack the Grid*: you. You are a part of everything you consume—food, material goods, energy—and everything you consume affects the world you live in. It's like a giant feedback loop. You don't necessarily want a feedback loop in the electrical circuit you're building, but you need those loops everywhere to write a useful computer program. The thing is: just like you decide what loops in your code, you should be able to choose what you send into that bigger feedback loop in the world. As they say: "garbage in, garbage out." Know how to gather good data and understand what it means. Make your choices based on quality information that you have verified yourself, not junk that someone else feeds you. You are made of energy and have the power.

12. Learn from what others have done, share your experiences, and build your own communities of grid hackers. In *Hack the Grid*, we present a series of case studies that demonstrate how diverse individuals and initiatives have come together to start making a difference locally and globally.

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