

# HOW THE INTERNET OF THINGS IS HELPING TO FIGHT CLIMATE CHANGE

BY RANIZ BORDOLOI AND JEFFREY LEE



# HOW IOT IS HELPING TO FIGHT CLIMATE CHANGE

In 2018, the west coast was on fire and the east coast was flooding. If it wasn't clear before, it is abundantly clear now. The cost of ignoring climate change is only becoming worse. While it may not seem like much is being done to protect the environment, many entrepreneurs have been turning to the Internet of Things to counteract the effects of climate change and other environmental hazards.



↓ 15%  
Emissions

Experts believe IoT will help reduce carbon emissions across sectors by 15%.

60Bn  
IoT Devices

By 2025, experts believe 60 billion IoT devices will be deployed worldwide.

\$11.1  
Trillion

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In fact, experts estimate that IoT could account for a 15% emissions decrease across industry sectors by 2030. Additionally, by 2025, industry experts believe there will be more than 60 billion IoT devices deployed worldwide. With so many devices, IoT is expected to have an economic impact of \$11.1 trillion a year. As such, the possibilities afforded by IoT are abundantly clear, which is why so many climate advocates and entrepreneurs have been turning to IoT to counteract climate change.

## How can IoT technology help the environment?

From smart energy programs to connected water management systems, IoT technology enables numerous opportunities to monitor and protect the environment. Here are some ways we have seen product creators and companies use IoT to protect the environment:



### 1. Renewable energy adoption

Companies are using IoT to collect, store, and manage renewable energy during the day.



### 2. Carbon emissions reduction

Product creators are starting to connect stoves, trucks, and other assets to reduce carbon emissions.



### 3. Monitoring a changing environment

Many organizations are using sensors to collect data and respond to environmental indicators.



### 4. Mitigating extreme weather

Companies are building technologies like flood trackers and seismic sensors to prepare for disasters.

To further illustrate how IoT is impacting the environment, this paper will explore how IoT enables the above mentioned use cases. This paper will also shed light on Particle's approach to environment protection and how we have helped customers develop IoT solutions to combat climate change.

## 1. Renewable energy adoption

We've now reached a point that renewable energy generation from sources like solar and wind are cost competitive, if not cheaper, than generation of fossil fuels. The challenge facing us now in renewable energy adoption is storage. Why? Because unlike fossil fuels, renewables can only be generated at certain times of day – and these times do not line up with when this energy is needed.

### Shifted Energy is driving the energy economy to 100% renewable

However, companies like Shifted Energy are changing this paradigm by retrofitting already deployed water heaters into grid interactive water heaters (GIWH). A grid interactive water heater can essentially act as a battery to temporarily store renewable energy during the day. This temporarily stored energy can then be used by utility companies during peak hours to balance the grid and maximize efficiency.

In September 2018, Shifted Energy deployed the first fully-integrated GIWH retrofit solution at Manoa Gardens, an elderly assisted living facility in Hawaii. The five-year pilot program is backed by Hawaiian Electric and Hawaii Energy to demonstrate the economic viability of using GIWH devices as demand response assets. Shifted Energy's GIWH device is connected to the Internet via Particle's E Series, which allows utility companies to control the device remotely and collect data.



Shifted Energy's solution is designed around the benefits of IoT cellular communication due to the Particle E Series. Shifted Energy learned that cellular-connected devices are easier to install because they require no onsite configuration. Mass installations can be arranged with property managers instead of interacting with each resident, which saves time and energy. Due to the low maintenance costs, it enables renters to engage in grid modernization programs.

Shifted Energy's Power Controller platform represents a new approach that integrates reliable, low-cost connectivity hardware with advanced software controls for cost-effective, rapidly scalable GIWH solutions. This is critically important for renters and other hard-to-reach communities like assisted living facilities, because it gives them a no-cost means to engage in renewable energy programs.

## 2. Carbon emissions reductions

Burning fossil fuel contributes to two third of greenhouse gas emissions, and considering that energy-related CO2 emissions is estimated to increase by 16% by 2040, it is pertinent that we find ways to reduce our reliance on fossil fuels. IoT technologies have opened doors in that direction by enabling us to monitor usage levels, and forecast demand more accurately, translating to a reduction of energy consumption by fossil fuels.

### Envirofit reduces carbon emissions by monitoring oven usage

Over 3 billion people around the world cook with biomass over open fires inside their home, which releases large amounts of CO2 and other harmful emission in the air.

And while cooking over an open fire might seem romantic to some, it comes with a heavy price to families and the environment. The use of wood-fired stoves releases large amounts of CO2 and other harmful emissions that actively contribute to climate change. In fact, open fires produce over 1 billion tons of CO2 and are responsible for roughly 25% of all global black carbon emissions.



However, governments in emerging markets are working to bring electricity, modern cooking, and a better quality of life to their citizens, but those efforts are typically slow moving. That's why there remains a strong need for more immediate solutions to the problem of energy poverty.

To overcome this problem, Envirofit designed and deployed a low emission, green energy, cookstove as a way to replace wood-fired stoves. To ensure these cookstoves were being adopted, Envirofit equipped 1000 of them with the Particle Electron to collect data on energy stove usage.

With the Particle Electron, Envirofit was able to stave off data loss and gain a greater understanding of cookstove usage, ensuring that customers use the stoves and reduce carbon emissions through clean cooking.

## Carboncure reduces the carbon footprint of the concrete industry



While reducing the use of fossil fuels is one way to counter carbon emissions, we are seeing the emergence of newer technologies that use carbon dioxide as value-added products, for the purpose of creating greater demand for its capture. One such company, CarbonCure is using CO<sub>2</sub> captured from industrial emitters to improve the manufacturing process of concrete, whose essential ingredient - cement - is responsible for 7% of global CO<sub>2</sub> emissions. The CarbonCure Technology injects CO<sub>2</sub> into concrete, where it becomes chemically converted to a mineral and permanently embedded. The process improves the strength of the concrete, which enables concrete producers to realize manufacturing efficiencies which further reduce their carbon footprint. CarbonCure is exploring opportunities to leverage the Particle platform for international growth and technology scalability.

## XStream Trucking innovates transportation to reduce carbon emissions

Transportation is another key sector that requires innovative solutions to combat carbon emissions. According to the California Environmental Protection Agency, transportation alone accounts for more than 36% of the state's greenhouse gas emissions, which is the largest of any sector.

Companies like XStream Trucking are spearheading the movement to reduce carbon emissions in the transportation sector. They have developed an aerodynamic solution called TruckWings™. These "wings" (a set of panels) deploy on the back of a truck cab when the truck is at high speeds. When deployed, these panels close the gap between the truck and the trailer, which helps save fuel because the truck is more aerodynamic. With this solution, XStream Trucking is helping to reduce the number of carbon emissions generated in the United States from long-haul transportation.

## 3. Monitoring a changing environment

Many organizations and product creators have turned to low-powered sensors to monitor remote environmental conditions and assets. By connecting remote objects to the Internet, entrepreneurs can collect data on external parameters and make smarter decisions that directly or indirectly affect our fight for climate change reduction.

### Scientists deploy an IoT network to battle Kilauea's deadly fume



For example, Scientists at MIT and the Kohala Center used Particle's IoT platform to create the Hawai'i Vog Network. The network provides real-time measurements of hazardous fumes like sulfur dioxide and particulate matter in Hawaii. The network collects data using low-powered sensors that are stationed near eruption zones and are connected to the Internet via a Particle Electron. The data collected from these IoT sensors are helping scientists learn more about pollutants in the atmosphere and helping citizens know what areas of the island to avoid.

### Wiping out climate change with Smartfin

Product creators are also using IoT technology to monitor the ocean. Environmental scientists at the Scripps Institution of Oceanography used Particle's hardware to create Smartfin, an IoT enabled surfboard fin that contains environmental sensor. This Electron-powered surfboard fin tracks board location, water temperature, and pH levels. With the data collected, they hope to provide policymakers with the insights they need to make informed decisions about the environment.

## 4. Mitigating extreme weather conditions

One of the most well-known effects of climate change is increased frequency, intensity, and duration of extreme weather events like hurricane, droughts, and floods. According to the World Economic Forum, these extreme weather events are among the top risks posing a threat to global stability. While the impact of these events can be unprecedented and multifold, technologies like IoT can help with climate change mitigation and preparedness.

### Opti stops floods before they start

Today, the vast majority of cities aren't equipped to handle the environmental damage that can occur from earthquakes, hurricanes, and floods. In 2016, the Congressional Budget Office estimated that hurricane damage cost \$28 billion a year alone. Fortunately, companies like Opti have developed ways to combat inadequate infrastructure with IoT solutions that deliver continuous protection to the cities they power.



*Opti's Smart Stormwater Management System*

Opti's CMAC (continuous monitoring and adaptive control) drainage system monitors weather forecasts and controls drainage valves to minimize flooding and environmentally hazardous runoff in cities. With Opti's device, cities can connect and manage stormwater systems at scale. Opti's CMAC system is connected to the Internet via Particle's platform, which allows cities to manage these assets remotely and stream valuable stormwater data to the cloud.

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By installing these CMAC systems around cities, Opti has created a smart solution that helps prevent flooding. With Particle serving as the engine of connectivity, Opti's CMAC system has already proved to be effective as it greatly mitigated the after effects of Hurricane Irma in 2017. Currently, Opti's stormwater system continues to expand across the United States, and can be found in notable major cities like Kansas City, MO, Philadelphia, PA, and Albany, NY.

## Code For Miami combats rising sea levels with IoT flood trackers



A local maker group known as Code for Miami has even used IoT for disaster preparedness. The local maker group collaborated with the city of Miami to build a fleet of IoT flood trackers that will help combat the rising sea levels in Miami.

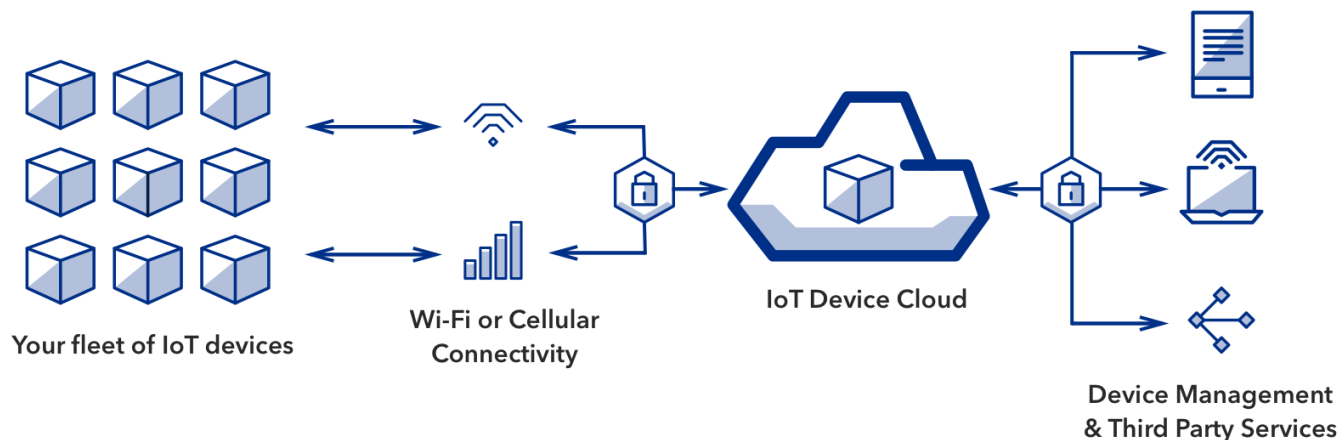
The flood trackers were powered by Particle's Electron and were placed around the city to help gather flood data. This data will help the city's efforts at rebuilding infrastructure that adapts to the rising water levels, which will help keep businesses, homes, and everyone in the city safe.

## Grillo detects earthquakes before they occur

Similar to flood trackers for disaster preparedness, Grillo has developed a system for detection and alerting of earthquakes. They are using the Particle Electron to connect their seismic sensor networks with accelerometers deployed in Mexico and Chile. These networks enables them to perform parallel algorithms to detect earthquakes, and offer up to 120 seconds of advanced warning and alarm. They also plan to use Particle's Mesh connectivity for their building monitoring systems. The mesh networks will help to notify occupants of the health status of the structure after an earthquake and signal if it is safe to re-enter after.

## Developing your own environmental IoT project

The consequences of climate change are multifold and will compound as our population increases. If you're looking to develop your own connected solution to combat environmental issues, Particle's platform includes everything you need to power an IoT device.



Particle provides your business with the **hardware, software, and network infrastructure** it needs to overcome the innumerable challenges of IoT.

## Particle offerings

Particle provides everything you need to power your IoT product, from device to cloud:



### IoT Hardware (Wi-Fi, Cellular, Mesh)

Connectivity hardware that is designed for building IoT products and devices



### Developer Tools

Software development tools for every layer of your IoT stack



### Device management

A web interface for managing and provisioning remote IoT devices



### Device OS

An operating system that handles the complexity of IoT infrastructure



### Device Cloud

A reliable gateway between your IoT devices and the Internet



### Cellular IoT SIMs

Low-cost SIM cards designed for low-bandwidth IoT devices

## Benefits of using Particle

Developing your own connected device has a few key benefits. First, you can easily customize and tailor a solution to meet your organization's specific needs. You will not be tied to a rigid system that cannot adapt to your fleet's evolution and shifting requirements. Second, you can scale new revenue channels by having open access to any business or performance data you need, and integrate these data streams into your existing analytics platforms. With this data, you can take action in the physical world using predictive analysis on both real-time and historical data, which, in turn, trigger actions on devices or through other web services

## How to start your own environmental IoT project

Starting your own IoT project may seem challenging or near impossible (as a matter of fact, nearly three-fourths of self-initiated IoT projects are considered a failure, while a third of all projects were not seen as a success). The two biggest contributors to the failure rate are: lack of internal IoT expertise and platform (hardware/software) reliability. With Particle, you have full access to IoT experts, a large community of IoT enthusiasts, support services, and professional engineering services to help you get your IoT projects off the ground.

## Create a brighter future with Particle for Good

If you're an organization, non-profit, or academic institution that is planning to or already creating a brighter future with IoT, the Particle for Good program can provide benefits to support your initiative.

At Particle, we see IoT as more than just a business opportunity. We see it as a way to make positive societal impact. The Particle for Good program provides qualified organizations with additional resources and benefits like discounted hardware and device cloud costs, priority support, and access to our private communities. If you're interested, you can learn more about the Particle for Good program [here](#). You can also start prototyping your project now or talk to our team of experts by checking out the links below.

### Check out the Particle store



Start your IoT journey by checking out our industrial hardware on the [Particle Store](#).

### Contact our experts



Contact our team of experts at [Particle.io/sales](https://particle.io/sales) to discuss solutions development.

## Consult Particle's IoT experts



### **Raniz Bordoloi** | Business Development at Particle

As an economics major from UC Berkeley, with a background in public policy, Raniz specializes in helping clients in the energy and environment industry to implement IoT solutions from prototype to deployment at scale.

 [raniz@particle.io](mailto:raniz@particle.io)



### **Jeffrey Lee** | Technical Content Writer at Particle

Jeffrey Lee is a technical content writer at Particle where he writes and designs articles that explore the complexities of IoT. In his spare time, he writes original content for world-renown tech publications and is currently finishing his MSc in Technical and Professional Communication.