



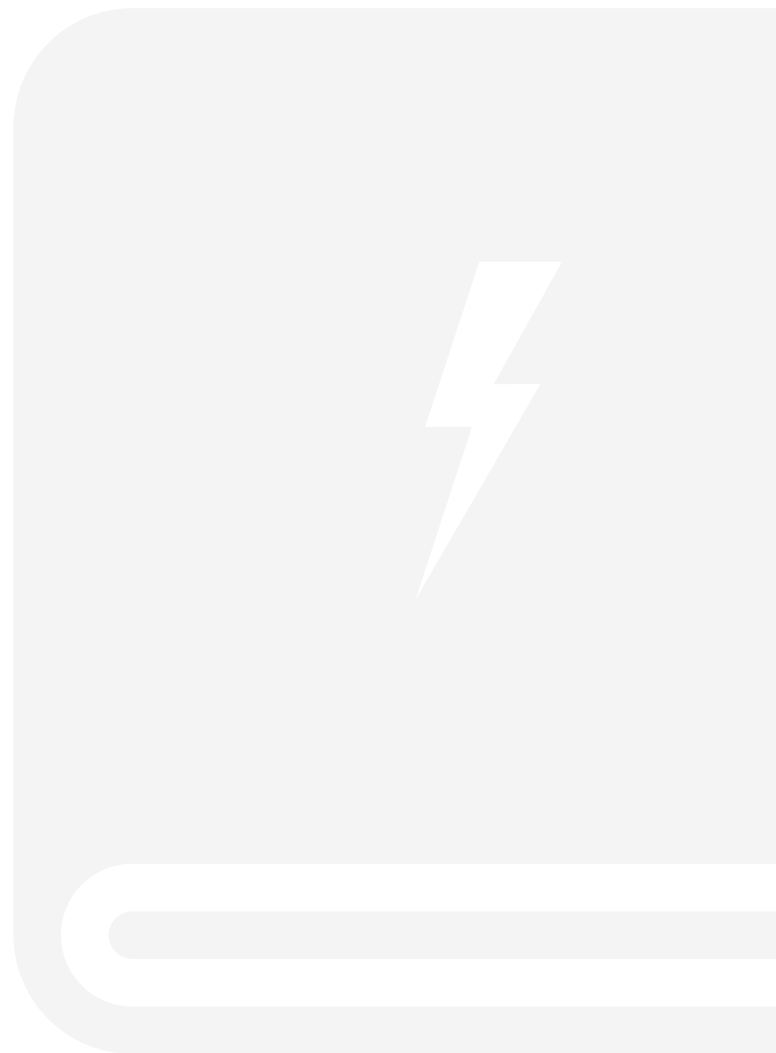
THERMOELECTRIC SURVIVAL GUIDE:

POWER OUTAGE
EDITION



TABLE OF CONTENTS

INTRODUCTION	1-3
CHAPTER 1: HELP MY FIREPLACE WON'T WORK!	4
CHAPTER 2: HELP MY CELL PHONE DIED!	5
CONCLUSION	6-7



INTRODUCTION

The US has been hit with many catastrophic winter storms over the past decade. These disastrous weather events have left thousands of people stranded without power for days and sometimes even weeks at a time. While government and local emergency agencies struggled to respond- most people were left to fend for themselves and protect their families in hostile environments.

The CDC recommends every person put together an emergency preparedness and response kit complete with first aid, non-perishable food, safety supplies, thermal blankets, communication devices and a range of camping style survival equipment.

THIS KIT SHOULD INCLUDE:



Water



Battery-powered radio



Non-perishable food



Flashlights



Extra warm clothing



Extra car keys



Extra blankets



Credit cards and cash



Sturdy shoes



Extra provisions for infants and children



First aid



Pocket lighters



Extra eyeglasses



An ax and shovel

INTRODUCTION CONTINUED

However emergency preparedness kits do not account for the failing of electric appliances such as electric furnaces, cellular phones, and mobile devices. There is a range of emergency power supply options that harvest energy and can help such as extra batteries, solar, and wind power- but all of these can fail. Keeping extra batteries on hand helps but they can quickly be depleted.

Energy harvesting is an alternative energy solution that harnesses natural energy and converts it into electricity. It does not require access to an electric grid; rather energy is harvested from the surrounding environment. Sources such as wind, radio waves, solar power, kinetic energy, salinity gradients, and temperature gradients can all be converted to usable electricity.

Thermoelectric energy harvesting relies on either natural or manmade temperature differences to harness energy and convert it to electricity.

Thermoelectric generators convert temperature differences into energy and operate according to the Seebeck Effect (see aside). Generally thermoelectric generators, when combined with electrical storage elements such as rechargeable batteries are used for industrial application, however their ability to harvest, accumulate, and store or scavenged energy could also be used to power common household items that require electricity to operate.

When applied correctly, thermoelectric generators can indefinitely power small electronic devices that are critical during an emergency. Unlike solar or wind power, electricity generated by a thermoelectric device can be easily obtained from a constantly accessible source such as fire.

INTRODUCTION CONTINUED

In this survival guide we will cover several different scenarios where a thermoelectric generator could be used to create consumer solutions for any emergency preparedness and response kit.

ASIDE: THE SEEBECK EFFECT

Discovered by Thomas Johann Seebeck in the 1800s, the Seebeck Effect is the conversion of a temperature differences directly into electricity. Seebeck discovered that if two metal wires were connected in a closed loop and a temperature difference was imposed between the two junctions, something strange happened: the wire loop deflected the needle on his compass. At the time, he didn't fully understand that the electric current being generated in the closed loop was creating a magnetic field that caused his compass needle to move. He did observe that if the temperature difference was increased, the needle on his compass deflected more.

Seebeck's discovery laid the groundwork for modern day thermoelectrics. The Seebeck coefficient, generally expressed in $\mu\text{V}/^\circ\text{C}$ (that's 0.000001 V/degree Celsius), is a quantity that can be measured for any metal or semiconductor. Our present day thermoelectric materials are special semiconductors that have Seebeck coefficients that are 1-2 orders of magnitude higher than common metals such as steel, copper or aluminum. And just as Seebeck observed with his compass needle, the larger the temperature difference that is imposed across a thermoelectric junction, the higher the voltage that can be generated. A theory that claims an electrical current is produced when dissimilar metals are exposed to a variance of temperature.

Have you ever wondered how many of our deep space probes, like the New Horizons space probe that recently sent back close up pictures of Pluto, could travel billions of miles into space without running out of power? Many of them have been powered by Radio Isotope Thermoelectric Generators (RTGs). This is basically a thermoelectric device that is connected a radioactive isotope that gives off heat as it decays. The heat from the isotope provides the temperature difference for the thermoelectric device which then generates power for the space probe. Combining a solid state thermoelectric generator which has no moving parts and is inherently reliable with a radioisotope like Plutonium 238 that has a half- life of almost 90 years, creates the ideal power source enabling these spacecraft and probes to travel billions and billions of miles into space.

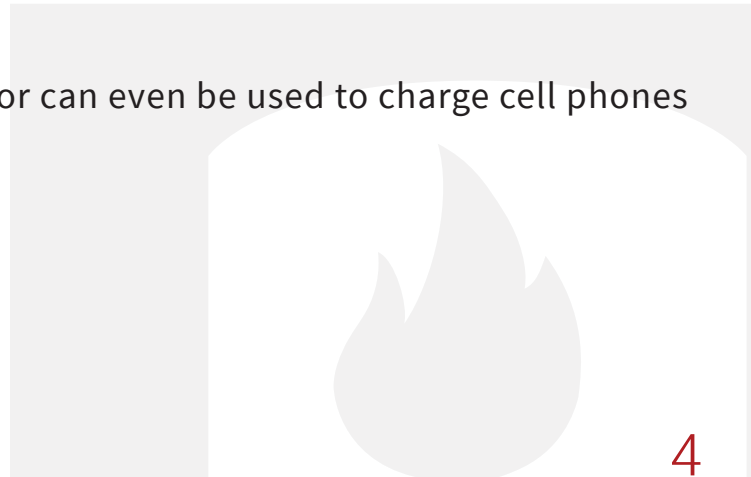
CHAPTER 1: HELP MY FIREPLACE WON'T WORK

Gas fireplaces are becoming more and more popular. Driven by regulations and the ease of lighting and controlling your fireplace from the convenience of a remote control, many homeowners may not realize that they are more vulnerable to not having their fireplace as a source of emergency heating during power outages during winter storms. These new electric fireplaces require power in order to power the ignition systems, communicate with the remote control and to keep the gas valve open so that the fire remains lit. While these new gas fireplaces have battery backups, many only can operate on battery backup for a matter of hours....if the homeowner remembered to keep a fresh set of batteries installed!

HOW A THERMOELECTRIC GENERATOR CAN HELP

Thermoelectric generators are devices that use the Seebeck Effect to generate small amounts of electricity from the heat from the fireplace, to provide the power source needed for these modern day gas fireplaces. A single thermoelectric device can easily provide sufficient power to power the electronics to keep the fireplace fully functional no matter how long the power outage. In addition, if the fireplace is properly equipped with multiple thermoelectric devices, sufficient power can be harvested to power the blower to help circulate the heat within the room as well.

Any excess energy generated by the generator can even be used to charge cell phones or other electronic devices.



CHAPTER 2: HELP MY CELLPHONE DIED!

New government statistics released last December showed that almost half the homes in the US only use cellphones and no longer have a hardwired landline phone. During power outages, when your cellphone becomes your primary means of communication for not only phone calls but also internet communication, wireless devices may only last hours without an alternative source of electricity. Even if a person does not use their phone, and saves it for emergency use- most of these devices will only hold their charge for one or two days. If a household has more than one cellular phone, it would be best to shut one down completely while leaving another in a low power use mode in case of incoming calls. Even using precautions such as these, cell phones will not last more than one week.

HOW A THERMOELECTRIC GENERATOR CAN HELP

Just as with a gas fireplace, thermoelectric generators can be used to resuscitate cellular phones. By storing energy created by these devices in a chargeable unit, stored energy can then be used to power wireless communications devices. Numerous thermoelectric based products are now on the market that incorporate USB charging of electronic devices. These include small campstoves, stovetop pots, and candle powered chargers that utilize a thermoelectric generator to provide an ideal source of emergency power.

ADDITIONAL BENEFITS OF THERMOELECTRIC GENERATORS

- Thermoelectric devices are compact and can be taken on camping trips where emergency energy supplies may be necessary for survival
- Do not rely on inconsistent and unpredictable sources of energy such as solar power or wind
- Can be charged whenever a fire is lit
- Safe, does not risk possible combustion

CONCLUSION

The kinds of damage that winter storms can do to the power grid infrastructure can cause power outages that last for days at a time- sometimes for weeks- after a significant weather storm or other disastrous events.

Emergency kits can be a good place to keep extra batteries. These emergency batteries should be replaced regularly to ensure functionality and it is very common for batteries not put into immediate use to fail in emergency situations.

Thermoelectric generators are an ideal, reliable source of energy during an emergency or as a back-up source of power. Utilizing the Seebeck Effect (see aside), generators provide an alternative source of energy when there is no access to the electric grid. Unlike solar or wind power, thermoelectric generators depend on a source of energy, such as fire, that can be produced anywhere at anytime.

Additionally, thermoelectric generators are mobile, compact and safe to operate. Modules require little or no maintenance and unlike batteries, modules do not need to be recharged or have a limited lifespan. II-VI Marlow produces several different thermoelectric generators that are designed to provide DC power to a wide range of devices. Modules are constructed to survive a high number of thermal cycles and up to 200°C on the hot side of operation.

CONCLUSION CONTINUED

We recommend II-VI Marlow products for any person looking to produce alternative energy solutions to create safer, more energy efficient innovations. If you would like more information about II-VI Marlow's thermoelectric generators, contact us today. Numerous thermoelectric based products are now on the market that incorporate USB charging of electronic devices. These include small campstoves, stovetop pots, and candle powered chargers that utilize a thermoelectric generator to provide an ideal source of emergency power.

