Surviving on Solar: Special Medical Needs

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Introduction

There are over 44 million people in America that suffer from sleep problems. Sleep Apnea is one of those sleep problems that can be critical to the life of the person suffering. It is a medical condition where the person stops breathing in their sleep from 5 to 90 times an hour.

Some people require a Continuous Positive Airway Pressure machine that forces air into their lungs making them breath. People with CPAP machines require a continuous supply of electricity to keep the machine operating while they sleep. Power outages caused by bad weather, accidently or by a disaster can be life threating.

There are portable CPAP machine with batteries, but the batteries do not last long. The best solution for powering critical items is photovoltaic (solar electric) power systems that provide quiet, reliable, emission-free electricity fueled by the sun. Photovoltaic (PV) power systems can be a portable generator from 100 to 400 watts or a permanently mounted system on buildings from 1000 to 4,000 watts.

What is Sleep Apnea

Sleep Apnea is a serious potentially life-altering health issue that a condition in which a person stops breathing repeatedly during sleep reducing oxygen levels. Sleep patterns are disrupted, resulting in excessive sleepiness or fatigue during the day. It is a medical condition where people stop breathing in their sleep from 5 to 90 times an hour. There are two types:.

- Central Sleep Apnea, CSA, is when breathing is interrupted by improper signals from the brain.
- Obstructive Sleep Apnea, OSA, is when the throat airway closes off the air flow to the lungs.

Sleep Apnea is caused by several reasons:

- Extra tissue in the back of the though airway such as large tonsils.
- Decrease in the tone of the muscles holding the airway open.
- The tongue falling back and closing on the airway.
- Signals from the brain not triggering the lungs to compress and expand to exchange air.

Sleep Apnea Treatment

A sleep study determines the extent of the problem where you are monitored while sleeping and body function are measured. The most widely used treatment is with a breathing machine of three different types.

CPAP – Continuous Positive Airway Pressure.
APAP – Automatic Positive Airway Pressure.
BiPAP – BiLevel Positive Airway Pressure.

Also, there are other devices used, but not as often, such as TAP – Thornton Adjustable Positioner Oral appliance mouth device.

CPAP Machine Design

System Configurations

There are about 20 different CPAP machines by five different manufactures. Many can use both US 120 VAC or EU 240 VAC. There are the AC only powered machines and the AC/DC machines with the DC machines made for travel. Some AC/DC machines have a battery as part of the device, while others have a separate battery connected by cable. Operating times for travel machines range between 4 to 10 hours. Most use 12 or 24 DC for a DC sources. The power consumption varies with the feathers of the machine as follows:

- CPAP
- Data Transmit mode
- Humidifier and heater hose.

There are third party battery packs and photovoltaic module packs made for CPAP machines.

Power Consumption

Power consumption varies from 40 to 150 watts per hour based on features of the machine. The following is a list of machines designed for home or travel operations.

Home Operation Machines Values

Model name	Power
▪ ResMed AirSense	▪ 120 VAC, 53W, 104W,
▪ XT Fit	▪ 100/240 VAC, 60 W,
▪ ICON Premo	▪ 100/249 VAC, 150 W
▪ Airstart 10	▪ 100/240 VAC, 110 W
▪ SleepEash II	▪ 100/240 VAC, 90W
▪ Dream Station	▪ 100/240 VAC, 110 W
▪ S9 Escape	▪ 100/240 VAC, 70 W, 110 W
▪ S8 Elite	▪ 100/240 VAC, 110 W
▪ Sleep Style 604	▪ 100/240 VAC, 90 W
▪ AirMini Autoset	▪ 100/240 VAC, 100 W

Home Operation Machines

Travel/Overnight Machines

Model name	Power
▪ ICON Premo	▪ 100/240 VAC, 24 VDC,150W
▪ AirMini Autoset	▪ 100/240 VAC, 6.3 W, 1 W
▪ Z1 Overnight	▪ 100/249 VAC, 150 W, Battery
▪ BreathX Journey	▪ 100/240 VAC, 40W, 12 VDC ch
▪ AE10 Med Everst 2	▪ apt 13.5 VDC,60 W charger
▪ Curasa EUT	▪ 100/240 VAC, 100 W, DC port

Battery Pack and Solar Devices

Model name	Power
▪ Z1 Overnight	▪ 13.4 VDC, 45 Wh battery
▪ Transcend Multi Night	▪ 100/240 VAC, 5.2 AHr
▪ Respironics Travel kit	▪ 24 VDC, 40 W, Battery
▪ BPS sunpower 40	▪ 40 W, 14 VDC, PV module
▪ Solar Charger	▪ 12 VDC, 14 W, DC port

CPAP Loads and Energy

The more hours you sleep, The more energy you consume. From 40 to 150 watts are the different wattages for the different devices.

1 hr	40 W	53 W	70 W	90 W	104 w	110w	140w	150w
2	80	106	140	180	208	220	280	300
3	120	159	210	270	312	330	420	450
4	160	212	280	360	416	440	560	600
5	200	264	350	470	520	550	700	750
6	240	318	420	560	624	660	840	900
7	280	371	640	640	728	770	980	1050
8	320	424	710	730	832	880	1020	1200

These machines have relatively low power consumption as compared to many other devices people depend on like air conditioning. Evaluating the loads and operation times from 4 to 12 hours, the user does not meets their needs during a long power outage caused by a disaster. There are other sources of power other then utility, such as generators and solar power systems.

Generator Technology

Conventional fossil fuel generator power comes with a price. Inexperienced users do not select the best generators for their needs and installation usually does not meet code and safety regulations. Small home generators are responsible for incidents of post-disaster burns, electrocution, fires, fuel explosions and even asphyxiation and death. High fuel costs, availability of fuel and safety are issues to consider. Many generators produce too much noise adding to the trauma of the power outage or disaster and the exhaust of the generator producing pollution.

Photovoltaic Technology

Photovoltaics (solar electric) is an environmentally benign, quiet, inexhaustible source of electrical energy. Photovoltaic cells convert sun light directly to electricity by converting one form of energy into another. Solar-powered equipment requires no fuel, so the length of operation poses no problem when the system is properly designed. Solar energy is a viable, cost effective source of power that can meet most energy needs.

Photovoltaic (PV) cell are wired into series and parallel circuits to construct modules of various sizes. PV modules come in typical voltages of 3, 6, 12 and 48 and wattages from 1 to 300. There are basically three different types of PV cells commercially available that produce direct current (DC) electricity.

Typically, each system contains PV module(s), charge controller, batteries, various electrical safety devices, power distribution devices, and an inverter(s). The PV modules produce DC power which the inverter converts to AC power or 'household power'. Systems provide AC voltages from 120 to 480 to match the utility or to meet equipment requirement. Systems are designed to meet equipment loads ranging from a few watts to mega watts. Portable systems can provide 200 to 1000 watts and home mounted systems can provide 1,000 to 10,000 watts.

PV modules are assembled into systems to produce various power and energy outputs. Stand-alone systems are not connected to the utility grid and operate in remote locations and store energy within the system for continuous operation. Utility grid-tied systems depend on the utility generator to produce electricity and transfer energy between the grid and the PV systems. Grid-tied systems do not operate if the utility is not working. Utility interactive PV systems are bimodal in configuration combining both stand-alone and grid interaction designs. Hybrid designs integrate other renewable sources into the PV system.

When the power goes out, you may want to keep the refrigerator running, lights on and be able to operate a radio or small television for the latest news. But, most importantly, your special needs life support equipment, your CPAP machine.

Real Life Example

The author, has over 30 years of experience with solar energy. Now, dealing with sleep apnea has come to appreciate the needs of people with heath issues as can be seen in this picture. His solar power home with storage that operator continuously even during power outages. His portable PV generator can also power his CPAP machine.

Conclusion

Many people suffering from Sleep Apnea depend on CPAP machines and a continuous supply of electricity. Inevitably, disasters, accident, storms and other failures cause utility power outages. Gasoline generator have their problems too. Times are changing as interest in solar increases and the solar industry grows. PV systems are being installed on increasing numbers of shelters, hospitals, business and homes. Not only can PV be integrated into buildings as a source of power, but also as a critical power supply in the event of a power outage and operates like a Uninterruptable Power Supply, UPS.

Portable solar power systems or solar powered homes are a viable solution to power outages for people suffering from sleep apnea. American power utilities have dome a extensive job to provide reliable electricity, but still there are power outages. The use of battery power CPAP machines is another solution during power outages, but only short term. People with sleep apnea have put lots of effort to over coming their health issues and solar is one solution.

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