2012 Instructions for Form 3468

Department of the Treasury
Internal Revenue Service

Investment Credit

Section references are to the Internal Revenue Code unless otherwise noted.

Future Developments

For the latest information about developments related to Form 3468 and its instructions, such as legislation enacted after they were published, go to *www.irs.gov/form3468*.

What's New

The qualifying therapeutic discovery project credit has been removed since the credit has expired.

General Instructions

Purpose of Form

Use Form 3468 to claim the investment credit. The investment credit consists of the rehabilitation, energy, qualifying advanced coal project, qualifying gasification project, and qualifying advanced energy project credits. If you file electronically, you must send in a paper Form 8453, U.S. Individual Income Tax Transmittal for an IRS e-file Return, if attachments are required to Form 3468.

Investment Credit Property

Investment credit property is any depreciable or amortizable property that qualifies for the rehabilitation credit, energy credit, qualifying advanced coal project credit, qualifying gasification project credit, or qualifying advanced energy project credit.

You cannot claim a credit for property that is:

- Used mainly outside the United States (except for property described in section 168(g)(4));
- Used by a governmental unit or foreign person or entity (except for a qualified rehabilitated building leased to that unit, person, or entity; and property used under a lease with a term of less than 6 months);
- Used by a tax-exempt organization (other than a section 521 farmers' cooperative) unless the property is used mainly in an unrelated trade or business or is a qualified rehabilitated building leased by the organization;
- Used for lodging or in the furnishing of lodging (see section 50(b)(2) for exceptions); or
- Certain MACRS business property to the extent it has been expensed under section 179 of the Internal Revenue Code.

Qualified Progress Expenditures

Qualified progress expenditures are those expenditures made before the property is placed in service and for which the taxpayer has made an election to treat the expenditures as progress expenditures. Qualified progress expenditure property is any property that is being constructed by or for the taxpayer and which (a) has a normal construction period of two years or more, and (b) it is reasonable to believe that the property will be new investment credit property in the hands of the taxpayer when it is placed in service. The placed in service requirement does not apply to qualified progress expenditures.

Qualified progress expenditures for:

- Self-constructed property means the amount that is properly chargeable (during the tax year) to capital account with respect to that property; or
- Non-self-constructed property means the lesser of: (a) the amount paid (during the tax year) to another person for the construction of the property, or (b) the amount that represents the proportion of the overall cost to the taxpayer of the construction by the other person which is properly attributable to that portion of the construction which is completed during the tax year.

For more information on qualified progress expenditures, see section 46(d) (as in effect on November 4, 1990). For details on qualified progress expenditures for the rehabilitation credit, see section 47(d).

At-Risk Limit for Individuals and Closely Held Corporations

The cost or basis of property for investment credit purposes may be limited if you borrowed against the property and are protected against loss, or if you borrowed money from a person who is related or who has an interest (other than as a creditor) in the business activity. The cost or basis must be reduced by the amount of the nonqualified nonrecourse financing related to the property as of the close of the tax year in which the property is placed in service. If, at the close of a tax year following the year property was placed in service, the nonqualified nonrecourse financing for any property has increased or decreased, then the credit base for the property changes accordingly. The changes may result in an increased credit or a recapture of the credit in the year of the change. See sections 49 and 465 for details.

Recapture of Credit

You may have to refigure the investment credit and recapture all or a portion of it if:

- You dispose of investment credit property before the end of 5 full years after the property was placed in service (recapture period);
- You change the use of the property before the end of the recapture period so that it no longer qualifies as investment credit property;
- The business use of the property decreases before the end of the recapture period so that it no longer qualifies (in whole or in part) as investment credit property;
- Any building to which section 47(d) applies will no longer be a qualified rehabilitated building when placed in service;
- Any property to which section 48(b) applies will no longer qualify as investment credit property when placed in service;
- Before the end of the recapture period, your proportionate interest is reduced by more than one-third in an S corporation, partnership (other than an electing large partnership), estate, or trust that allocated the cost or basis of property to you for which you claimed a credit;
- You return leased property (on which you claimed a credit) to the lessor before the end of the recapture period;
- A net increase in the amount of nonqualified nonrecourse financing occurs for any property to which section 49(a)(1) applied; or
- A grant under section 1603 of the American Recovery and Reinvestment Tax Act of 2009 was made for section 48 property

Renewable Industrial Process Heat

- About industrial process heat
- How renewable industrial process heat works
- Compatible renewable technologies

About Industrial Process Heat

The United States' industrial sector uses heat for a wide variety of applications, including washing, cooking, sterilizing, drying, preheating of boiler feed water, process heating, and much more. Altogether, the industrial sector uses and estimated 24 quadrillion Btu, or roughly one-third of the nation's delivered energy supply.! Process heating applications alone account for approximately 36 percent of total delivered energy consumption within the manufacturing sector (a subset of the industrial sector).? The vast size and scale of industrial heating energy use represents a unique opportunity for renewable resources.

According to a study of industrial heating in European countries, 30 percent of industrial heating applications require heat below 212^{0}F, another 27 percent can be met with heat between 212 and 750 ^{0}F, and the remaining 43 percent require heat above 750 ^{0}F.[3] Most existing renewable heating technologies can easily and cost-effectively supply heat within the lowest indicated temperature range. Often, the most valuable role that renewable heating technologies can play in industrial applications is to provide "preheating" before an existing conventional energy source is used. Major considerations for industrial renewable heating applications include cost, resource intermittency, and process integration and storage options.

How Renewable Industrial Process Heat Works

Solar, geothermal, or biomass sources can provide heat to support industrial processes that serve wateror air-heating end uses. As described above, more than half of industrial heating is met through temperatures below 750^{0}F, and some industries (agriculture, cooking) have much lower temperature needs. Many renewable heating resources can easily meet the lower temperature requirements. Even if renewable sources cannot support the entire heating load, they can still provide pre-heating to supplement a conventional heating process. Because it takes a relatively large amount of energy to raise the temperature of water (compared with heating air, for example), even a modest amount of pre-heating can reduce a facility's dependence on fossil fuels—and save money in the process.

Compatible Renewable Technologies

Flat-plate solar collectors and ground source heat pumps can support industrial processes requiring warm to hot water, such as pressurization or pre-heating water. Many agricultural processes also require gentle warming. For example, flat-plate solar collectors and ground source heat pumps can help to warm soil or warm water for fish farming to about 100 °F.

Chemical processing, kilning, drying, curing, sterilization, and distillation activities requiring higher temperatures can use evacuated tube solar collectors, direct use geothermal water, or biomass furnaces. Concentrating solar thermal technologies and deep geothermal wells can support the highest-temperature applications, such as fuel production, that require pressurized, superheated water or steam above 480 °F.

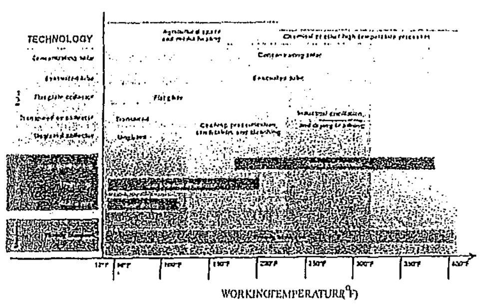
Agricultural and industrial facilities often take advantage of co-location and cogeneration. Waste agricultural products such as rice and corn husks can potentially serve as effective biomass fuels. Similarly, waste heat from a high-temperature industrial process can possibly support another process requiring a lower temperature.

The interactive diagram below shows how industrial processes align with selected renewable technologies. You can click any of the technologies to go to a new page with more detailed information.

Renewable Industrial Process Heat Technologies and Applications

Technologies and Applications

Applications



- View a text version of this diagram
- View an expanded version of this diagram to compare industrial process heat with other renewable heating and cooling applications

Understanding the Diagram

The diagram above shows technologies and industrial process applications in terms of the approximate "working temperature" range, which is the required temperature of the heat transfer fluid within the renewable heating system. The working temperature is not necessarily the same as the final temperature of the end product (in this case, the final temperature of the air or water that is being heated).

The diagram above shows approximate working temperature ranges. The exact working temperature requirements for a particular system will depend on factors such as system type, size, and location. The working temperature that a particular renewable technology can supply will also depend on sitespecific factors. For example, the amount of heat that a solar collector system can supply will depend on how much sunlight it receives, and at what angle.

Learn More About Renewable Industrial Process Heat

Key Renewable Technologies	Key End Use Sectors	Technical Resources
Flat-plate solar collector Evacuated tube solar collector Concentrating solar system Ground source heat Direct use geothermal Deep and enhanced geothermal Woody biomass	Breweries Industrial Processes	Project development tools

CWe've made some changes to EPA.gov. If the information you are looking for is not here, you may be able to find it on the EPA Web Archive or the January 19, 2017 Web Snapshot.

e,EPA

Solar Heating and Cooling Technologies

Can I use solar thermal technology where I live?

Solar thermal technologies can be used anywhere in the United States. However, some regions naturally receive more intense and more reliable solar energy than others, depending on latitude, typical weather patterns, and other factors. The National Renewable Energy Laboratory provides maps that show the solar energy potential where you live.

Solar thermal technologies absorb the heat of the sun and transfer it to useful applications, such as heating buildings or water. There are several major types of solar thermal technologies in use:

- Unglazed solar collectors
- Transpired solar air collectors
- Flat-plate solar collectors
- Evacuated tube solar collectors
- Concentrating solar systems

In addition to the solar thermal technologies above, technologies such as solar photovoltaic modules can produce electricity, and buildings can be designed to capture passive solar heat.

Solar energy is considered a renewable resource because it is continuously supplied to the Earth by the sun. Visit EPA's Clean Energy website to learn more about non-thermal solar technologies and the environmental benefits and impacts of solar energy.

Unglazed Solar Collectors

An unglazed solar collector on the roof of a pool and fitness center.
Credit: Albert Nunez, NREL 10651

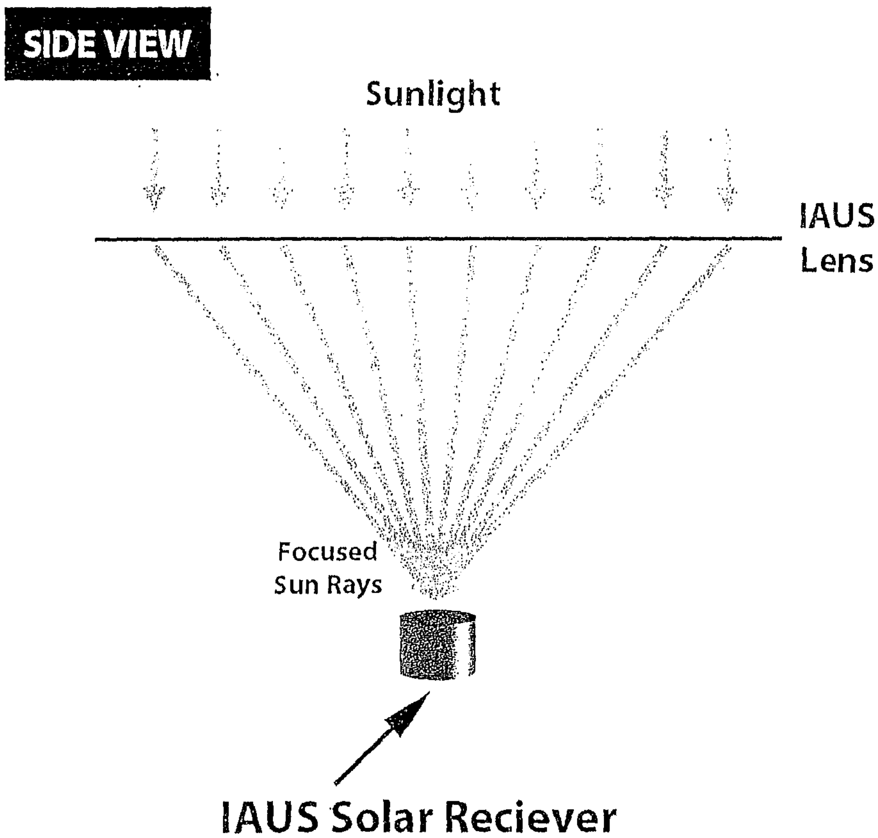
An unglazed solar collector is one of the simplest forms of solar thermal technology. A heat-conducting material, usually a dark metal or plastic, absorbs sunlight and transfers the energy to a fluid passing through or behind the heat-conducting surface. The process is similar to how a garden hose, laying out in the open, will absorb the sun's energy and heat the water inside the hose.

These collectors are described as "unglazed" because they do not have a glass covering or "glazing" on the collector box to trap heat. The lack of glazing creates a trade-off. Unglazed solar collectors are simple and inexpensive, but without a way to trap heat, they lose heat back to the environment and they operate at relatively low temperatures. Thus, unglazed collectors typically work best with small to moderate heating applications or as a complement to traditional heating systems, where they can reduce fuel burdens by pre-heating water or air.

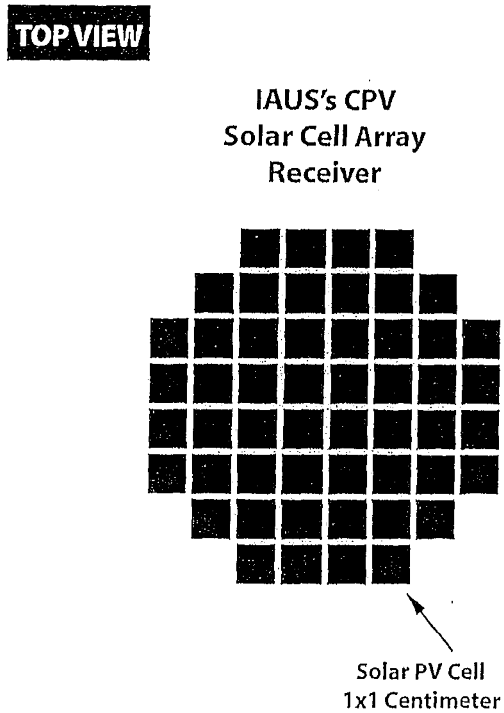
Solar pool heating collectors are the most commonly used unglazed solar technology in the United States. These devices often use black plastic tubular panels mounted on a roof or other support structure. A water pump circulates pool water directly through the tubular panels, then returns the water to the pool at a higher temperature. Although used primarily for pool heating, these collectors can also pre-heat large volumes of water for other commercial and industrial applications.

IAUS's Concentrated Photovoltaic (CPV) Solar Technology and Dynamic Voltage Controller (DVC)

Concentrated photovoltaic (CPV) solar technology has been lauded by some experts to be the next frontier in solar power solutions. Conceptually, CPV should be significantly lower in price than traditional photovoltaic (PV). It uses 1,000-2,000 times less PV cells than traditional solar. This is achieved by using less-expensive, large, mirrors or lenses to focus sunlight onto a PV cell embedded into a receiver. Also, the energy conversion efficiencies are much higher than both traditional PV and concentrated solar power (CSP). A simple illustration of IAUS's CPV technology can be seen in Figure 1. A top-view diagram of IAUS's CPV receiver is shown in Figure 2.



(Figure 1)

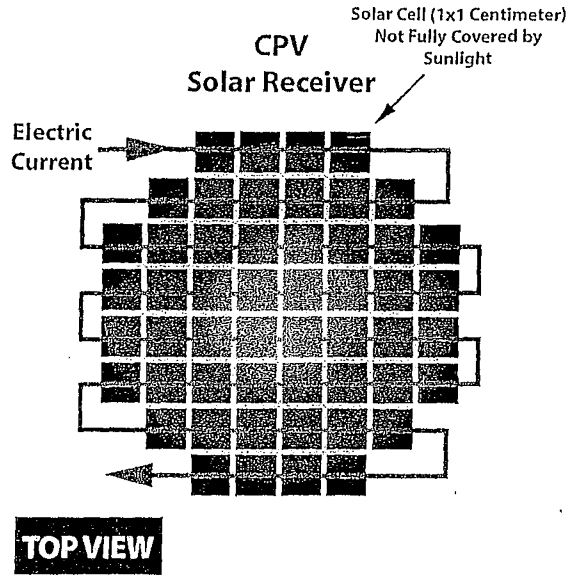


(Figure 2)

If CPV is conceptually less expensive than PV, why hasn't it already flooded the market, competing with fossil fuels? Among others, the primary culprit is the technological road block, or limitations of implementing a PV array inside the CPV receiver. In order to effectively counteract the cost of a duel-axis tracking structure, the solar concentration panels need to be large. This requires a bigger receiver. To sufficiently expand the CPV receiver, multiple PV chips must be tied together, forming an array. Otherwise, by using a single PV chip per each small, solar concentration panel, the duel-axis structure becomes too expensive in the economies of scale.

What complications does a traditional PV array cause within a CPV receiver? Upon connecting individual PV cells together into an array, they operate as a single unit. In other words, whatever affects one PV cell, affects all, like a string of Christmas lights. For example, a string of 25 PV cells capable of generating 25 watts will instead produce zero watts if even a single, one-watt PV cell in the string is shaded. In a CPV solar application, this problem becomes exponentially worse.

Figure 3 illustrates the issues facing today's CPV systems without IAUS's new DVC circuit. The red line shows current moving through each PV cell. All are connected together in series, and as such, must operate as one unit. The yellow circle represents a normal, uneven focal-point of sunlight focused onto the receiver by either mirrors or lenses.



(Figure 3)

For an array of PV cells to work, each cell needs an equal and even distribution of sunlight. As Figure 3 illustrates, with CPV this is not the case. By virtue of any large solar concentrator, some cells will have different intensities of light, others are only partially illuminated. Although 100% of the energy is hitting the CPV receiver, it will have almost no usable power output.

Bypass mechanisms have been developed to mitigate some of these issues, but even with an aggressive bypass design, less than 10% of the PV cells in Figure 3 would be generating power. Just one single solar cell not producing in a CPV treceiver is like losing 1,000-2,000 traditional PV cells. Secondary optics have been tested by some companies with the hope to evenly spread the sunlight across all the chips, but this introduces a new set of problems and power losses, and has, as of yet, not shown to be effective. Not to mention, Figure 3 does not illustrate the additional complications had by drifting, whereupon the focal point moves off center due to wind and/or structural flex while tracking.

IAUS's patented Dynamic Voltage Controller (DVC) resolves these issues entirely. Each PV cell functions independently, a feat never before possible. This capability prevents electric-current mismatches, hotspots, or interdependent power loss issues. Regardless of gaps, shaded PV cells, dirty glass, or uneven light distribution, IAUS's receiver captures maximum energy from its focal-point.

Combined with IAUS's revolutionary solar panels, proprietary, gearless, dual-axis tracking mechanism, and its new CPV receiver, the Company believes a new milestone in solar power economics is on the cusp of being reached. A price point capable of competing head-to-head with fossil fuels.

TO FURTHER APRICIATE THE COMPLIXITIES INVOLVED WITH CONCENTRATED SOLAR ENERGY A MORE DETAIILAED ANAYLIYSIS IS REQUIRED.

It's called the holy grail of solar why? What makes it so valuable? What makes it so difficult to achieve? These are all good questions and there are good answers.'s

It's called the holy grail of solar because it reduces by a factor of between 100 and 2000 times the amount of silicon or other more expensive semiconductor material. Making solar concentrated solar with extremely less expensive material say 100 to one or more if done properly gives at least 30 percent more energy with the same semiconductor material. Making it possible to use less expensive and more efficient semiconductor material which in turn reduces the overall cost of solar to electricity. And that is the proof that concentrated solar is the holy grail of solar. However, the promise also comes with a cost of both an investment of time and investment of capital.

Since 1960 there has not been a new invention in energy production. Solar semiconductosr first came available in its current format about that year. And it was expensive. So, 50 plus years have improved only the process of making the solar chips cheaper and still they are not cost effective. No not in more than 50 plus years they are still not capable of competing with fossil fuels. Billions of dollars have been spent and still no end in sight for practical solar energy. NO product in sight until now. Here is the reason. To increase production for the material the cost of making a semiconductor manufacture in facility is extremely expensive, extremely risky investment, and takes years to complete. The investment part still requires government subsidies to being even slightly competitive. That of course means that to induce inventors to invest the return on investment must be returned quickly. But the manufacturing facility requires long term investment. Possibly 30 plus years to amortize the investment. This situation is not sustainable. Therefore, it cannot succeed. It can only remain a niche market at best.

The second factor to overcome was that solar average daylight production is only about 5 hours per day. To make solar profitable the regular electrical production facilities will add additional cost to the power production facilities for several reasons. The base load still must be maintained because of the erratic nature of sunlight. The regular power plant therefor will cost the same but will have accommodate erratic changes in the market which of course increases the cost of the traditional power plants. This in turn increases the cost of power. So solar increase the cost of electricity in both the cost of the solar equipment but also the cost of the traditional electricity production faculties. This cannot dramatically change the existing market and will leave solar in niche market and probably collapses without government incentives.

Concentrated solar changes everything you know about solar. There three distinct ways in which to make solar energy profitable. However, in order to make concentrated solar profitable there must be at least three ways to utilizes the concentrated solar energy. Even concentrated solar pv systems by themselves will not make solar energy profitable. There must be at least three distinct ways in which to use concentrated solar energy and I will try to make it clear why it is required. Firsts it is necessary to be able to make concentrated solar pv systems work because this will dramatically reduce the cost of the semiconductor material cost by 100 to 2000 times. This is very important in reducing the overall cost. Next the material used to replace the semiconductor pv material must be very inexpensive and as production goes up the price comes down. This means that new material would have to be found or it must be invented. So, I invented the new lens. Also, the metal infrastructure would also have to be able to decrease as the production increased. Again, it needed to be invented and I did it. (Mirrors will never work for producing concentrated solar energy efficiently or productive for several reasons and we will discuss those reasons later.) So, I invented three ways in which to use concentrated solar energy. First the Johnson turbine. This uses heat directly to create electricity. It also uses other types of fuel to offset the production when needed to supplement the solar-thermal source. Next Invented the lens and the infrastructure to hold the lens and to move the lens to keep them tracking the sun. Next, I invented a way to make the solar pv cells work independent of all other cells. (the details of how this work will be discussed later) Then, I had to invent a way to store the summer sun so that this energy storage system would be cost effective and last forever and therefore could be used at any time to produce electricity. This is concentrated sulfuric acid and/or use capacitors. (more about this process will be discussed later.) To summarize the concentrated solar system uses 100 to 2000 times less semiconductor material. Again, this makes it possible to use more expensive and more efficient semiconductor material for the solar pv cell. Patented solar lens made of expensiveness plastic and massed produced. Then of course the unique steel structure and unique tracking device. Finally, the Johnson turbine that can use any fuel source including animal and human waste to produce electricity and of course solar-thermal heat and sulfuric acid to heat water for steam to drive the patented Johnson turbine. As a bonus the Johnson turbine can use nuclear energy as the heat source.

Dynamic Voltage Controller (DVC) third-party review by DR. David J. Corner, PhD.

The following is a third-party review of IAUS's DVC technology by Dr. David J. Comer, PhD, an expert in Electrical Engineering. Dr. Comer received his MSEE degree from the University of California and PhD from Washington State University. He has over thirty years of teaching experience as a professor at Brigham Young University, where he also served as Department Chair. Dr. Comer has published twelve text books in the area of circuit design,and has been published numerous times in trade journals. He served on the California Engineering Liaison Committee for five years and as Chair of the Council of California State University Deans of Engineering. In addition, Dr. Comer has worked as a consultant in the field of circuit design for IBM, Intel, and Lawrence Livermore Laboratories, and is a Fellow of IEEE.

VOLTAGE CONTROLLER PROJECT U.S. Patent No. 7,705,560

Basic Concept

The concept of this voltage controller is sound and its novelty was sufficient to be awarded a U.S. patent, namely U.S. Patent No. 7,705,560. A basic prototype has now been constructed and demonstrated to verify the practicality of the concept.

In principle, the voltage controller can be applied to several important areas of present day electronic circuit activity and to high energy systems with the potential to improve the performance-to-cost ratio of several important existing systems.

The precision of the voltage conversion for this voltage controller can be very good at the expense of increasing the number of capacitors used and the transistor switches required. From a practical standpoint, this tradeoff would have to be considered specifically for each application based on the specifications for that application. The numbers of transistors and capacitors along with their sizes will largely determine the component cost of a finished product.

Possible Applications

Some important areas of usage of the voltage controller are now listed.

1. Generation of multiple dc voltages from a single source

Portable electronic systems. DC voltage conversion is required in a large percentage of portable electronic systems. An obvious example is the cell phone. Older integrated circuit (IC) chips operated on a single battery, but required frequent charging to remain operational due to the high current drain for older transistors. More modern IC chips for cell phones have decreased the current drain from the battery by using smaller transistors that require less current. These circuits cannot withstand the higher voltages used in older circuits. However, other parts of the cell phone transceiver will require higher dc voltages to operate properly. A modern cell phone circuit may use 3 different voltages to drive different parts of the system while minimizing current drain [1]. These three voltages must be supplied by a single battery, thus, voltage conversion on the chip is necessary.

The number of cell phones worldwide almost equals the total population of the earth [2]. Furthermore, cell phone manufacturers continue to improve the technology each year. This area presents a potentially lucrative market if present methods of generating these voltages on an IC chip could be improved by the voltage controller.

Automotive power supplies. Another important use of voltage converters is that of automotive power supplies. A single 12-V battery must drive numerous electronic systems in modern automobiles. The many microprocessors now used in almost all automobiles, about 100 on high-end autos, require a lower voltage than that produced by the battery. Other systems such as airbags and entertainment systems require higher voltages up to 48 V [3]. This segment of converters is one to which the voltage controller could be effectively applied.

2. Higher power motor drives

DC motor drives: One large area of application of voltage controllers is the motor drive area. DC motors are becoming increasingly important in the area of robotic control. In addition, electric vehicles are often propelled by dc motors. A popular drive method uses the relatively complex H-bridge configuration that allows a dc motor to be driven in either direction. This method uses 4 power output transistors and must "float" the load that is being driven. This means that the load does not have the same common or ground terminal used by the drive circuitry. While this is not a disadvantage in many applications, there are those that would benefit if the motor and all circuit components have the same ground.

The voltage controller could replace the H-bridge configuration and drive the motor in either direction with only one or two power transistors. It would also allow the motor to connect one side of the armature to the circuit ground.

AC motor drives: The newer electric automobiles appear to be shifting from dc to ac motor drives. These systems require a converter to change the dc battery voltage to the ac voltage required by the motor. The voltage controller can make this conversion efficiently and could be used for this purpose.

The developing areas of robotics and automobile drives could benefit from high efficiency drive circuits that could be implemented by the voltage converter [4, 5].

These applications do not require precision control and could be implemented with a relatively small number of capacitors and transistors in the voltage controller.

3. Wind power turbine output voltage control

Another growing area in the world is that of power generation using wind turbines. With the large variability of wind speed, it is very difficult to control the output voltage within a necessary tolerance to connect to the grid or to supply energy to local users. Quite complex and inefficient control methods are now used to generate the required output voltages [6].

The voltage controller could easily control the output voltage regardless of wind and turbine speed. Again, the required precision in this application is not high. The number of capacitors and switching transistors would be relatively low for this application, although high-power transistors and capacitors would be required. This market appears to have great potential for a well-designed voltage controller.

4. Efficient energy harvesting from solar cell arrays

One problem in harvesting the electrical energy of a solar array results from the connection of the solar cells. In order to increase the voltage generated by an individual cell to usable levels, a string of cells is created by series connection. In order to increase the current output, a parallel connection of these series strings is desired. However, because of unmatched cells, shading, and malfunctioning cells, the series strings will not generate equal voltages making direct parallel connection difficult or impossible. In addition, a malfunctioning or shaded cell in a series string can prevent current from flowing in that string and lead to destruction of the cell [7]. Various methods are used to solve these problems, but there is an accompanying drop in efficiency of the array.

The voltage controller could monitor the performance of these cells and convert each string output to the same voltage. This voltage could then be easily combined with the other string voltages to result in an increased output current. Malfunctioning or shaded cells could also be detected and the remaining functioning cell voltages of the string could be placed in series by the voltage controller along with making the necessary adjustment of string voltage.

It would also be possible to convert the dc output of the solar cell array to ac using the voltage controller. This would be significant for either local appliance power or for connecting to an AC grid.

The main advantage that the voltage controller has for the solar industry is to make concentrated solar functionable by making each solar sale work independently from all other solar sales. This eliminates the problems of series or parallel connected solar cells.

5. Rapid charge/discharge systems.

Although electrical energy can be generated in several ways, the storage of this energy can be difficult or highly inefficient in systems that produce rapidly varying voltages. One example of such a system is the regenerative braking scheme used in electric automobiles. By drawing varying amounts of current from the motors that power the vehicle, these motors can provide braking torque while generating a varying armature voltage. This is referred to as regenerative braking. The amount of braking torque developed depends on the armature current drawn from the motor that is now acting as a generator. The original use of regenerative braking allowed the armature current to charge the batteries while braking takes place. This method has proven to be highly inefficient as the battery is not capable of extracting energy efficiently from surges of current driven by varying armature voltages.

Later designs have inserted capacitors or ultracapacitors between the motor and the battery in an attempt to recover the entire energy generated in the braking process. The capacitor can now absorb the total energy produced, regardless of the voltage generated by the armature. The differing amounts of energy produced in this way leads to different voltage magnitudes stored on the capacitor after braking. These voltages can be converted to the proper level by the voltage controller and used to efficiently charge the battery over a longer period of time. In this way, the energy produced by regenerative braking can be almost fully recovered by the battery.

In view of the growing popularity of electric vehicles, the development of a highly efficient regenerative braking system offers an important market potential for the voltage controller.

Although there are many other applications that could benefit from an efficient voltage controller, the preceding list covers a few potentially significant markets for further development.

Future Development of the Voltage Controller

The next step in the development of the voltage controller is to prove its value in one or two specific applications. For example, the wind turbine power generator would be a good system to demonstrate the advantages of the voltage controller.

The specifications on required maximum output current and percent load voltage regulation should be considered along with other pertinent specifications such as predicted wind speed variation. A prototype should then be designed and constructed to satisfy these specifications. The component cost of the working system can then be tabulated and the actual performance measured. A high performance-to-cost ratio compared to existing systems would demonstrate that the voltage controller prototype would be ready for production.

References

1. Xiao, Peterchev, Zhang, and Sanders, "An ultra-low-power digitally-controlled buck converter IC for cellular phone applications," *Nineteenth Annual IEEE Applied Power Electronics Conference and Exposition*, 2004.

2. *The Huffington Post.* Huff Post Tech, April 14, 2014 www.huffingtonpost.com/2012/10/11/cell-phones-world-subscribers-six-billion_n_1957173.html

3. www.Infineon.com/cms/en/product/applications/powertrain/microhybrid.html

4. www.maxonmotorusa.com/maxon/view/content/application_robotics

5. www.ni.com/white-paper/8223/en/