

BLAZE

Annual Technical Magazine

The Blaze bags for you.....

Editorials

Article-Faculty—Learn to say “NO’

Must read Book—Rich Dad Poor Dad

Story—A story from Buddha's life

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Recent Inventions in the Electrical Engineering Industry

Article-Student



Our motto Education for better society

We support Green Energy

We stand for Women Empowerment

About our department

Vision of the Department

To produce graduates in Electrical and Electronics Engineering with quality education by creating Center of Excellence in various domains, equip them in technical aspects to meet the industrial standards and provide an environment for quality research and continual learning in a professional way to serve the society with ethical mean for the development of the nation.

Mission of the Department

- Enriching the students in technical concepts through innovative teaching methods by qualified teachers.
- Introducing Industrial based education in correlation with the regular curriculum by establishing Centre of Excellence in various domains to meet the industrial standards.
- Inculcating the thoughts of innovation, research and continual learning to excel the students in their field of interest.
- Facilitating the students by creating awareness on leadership quality, professional ethics and human values in delivering their responsibilities to the society for the development of nation.

Program Specific Outcomes

- The students will be able to provide solutions for various technical problems through modern software tools and equipments such as PSPICE, MATLAB, LABVIEW, etc.
- The students will be able to develop and provide support to systems based on non-conventional energy sources.

Editorial

Four years, eight semesters of learning is the normal college life for most engineering students across the world. However, the electrical and electronics department, SVEW Tirupati can't be summed up the same. Innovations and creativity with countless times of breakthroughs and sleepless nights are what make the graduates of SVEW Tirupati. This comes plenty from the research based learning practiced in the campus.

To spread the this knowledge that we gain, we the content and design teams of the EEE association present to you BLAZE. Hope this edition of BLAZE is an enjoyable read to one and all, brings a smile to all as we experienced in creating it.

- B Roopa, Chief Editor

HOD's Message

I welcome all the students to the department of Electrical and Electronics Engineering.

The objective of the department is to prepare students for successful career in industry, Research and Academics to meet the needs of growing technology.

We provide opportunity for the students to work as members of team on multidisciplinary projects. The department provides students with sound foundation in mathematical, scientific and engineering fundamentals necessary to formulate, solve and analyze engineering problems and to prepare them for higher studies as well as research. We are committed to provide not only the technical education to our students but also the leadership qualities through which they can create employment to others.

- Dr. Shaik Rafi Kiran, HoD, EEE

“People are lovable only if they sacrifice their own needs before those of others and at the expense of their emotional well-being.” This exaggerated philosophical quote has now become a thing of the remote past. This ideology no longer holds true in this world of ever-changing thoughts and gossips. As kids, we are often taught certain moral and ethical values that we have to abide by, but some of those values cannot be applied in all the situations. One must not sacrifice one's priority before others. One must respect oneself and his/her needs before considering those of others. “When you say 'yes' to others, make sure You are not saying 'no' to yourself.”



The art of saying NO

One lives amongst a circle of people which includes family, friends, colleagues, acquaintances and many others. In an attempt to please the beloved ones, one remains unmindful of one's priorities and goals. One tends to give up on one's own accomplishments for the sake of pleasing others. One is rather ready to juggle between too many tasks rather than receiving help from others. But one must remember that one's own needs are more important than anyone else's. Learning to decline unreasonable requests must become a part and parcel one's life. When you do not have time to carry out your tasks, it is not advisable to commit oneself on peer tasks. One must learn to turn down such requests.

“It is only by saying 'no' that you can concentrate on things that are really important.” The inability to say no can make us exhausted, irritated and annoyed as we spend endless hours worrying over how to get rid of an already-promised commitment. However, the ability to say a no reflects our self-confidence and our stand. It clearly explains to the peer that our emotional well-being is more essential than that of others. People often mistake declining a request for being arrogant, head-strong and selfish. But selfishness and self-care are two very different things. Taking care of oneself and prioritizing one's thoughts before those of others can help us lead a life of satisfaction in the long run. It is, therefore, very crucial that we decline silly requests.

However, declining a request does not equate to declining the person at all. One must turn down the favor asked with a tinge of politeness. Refusal of a request with sufficient explanatory words can add to this politeness. People will understand that it is your right to say 'no' if you explain your actions genuinely. This will help you foster your relationship with the person, yet prioritize your own requisites before theirs. Mastering the art of saying 'no' has now become a pre-requisite to a healthy and happy living. “You can be a good person with a kind heart and all say NO”.

TIPS TO SAY NO

- Do not explain when not needed. Explaining the reasons for declining a request unnecessarily can cause uninvited issues among people. This can ultimately result in complete break-up of a relationship.
- Be polite while turning down. Words flaunting politeness and submissiveness can serve the purpose of fostering a valuable relationship while declining an unreasonable request.
- Provide an alternate. Suggesting other ways to accomplish the task that you had been asked to do can probably calm the person down and save you from the dread of hatred.
- Do not over-apologies. You are just turning down their request. You have every right to do so. You need not ask their consent for declining. It is your way of doing things. There is nothing to feel sorry about.
- Clarity of choice. Things that go against your moral and ethical values must not be entertained at any cost. Declining such a request, even if forcefully, is right. One must be able to distinguish between the right and wrong.

Acquiring the art of saying 'NO' is, hence, crucial to have a beer clarity in decision-making; for the smallest of your decisions can cause the biggest of damages in your life. The decisions that we make are, unfortunately, affected by our routine decision-making process. One must be careful in making the right decision and declining the wrong ones. Saying a single 'no' has all the potential to save you from the greatest of heartbreaks. You have the power to transform your life. Don't let others do it by not saying a 'no'.

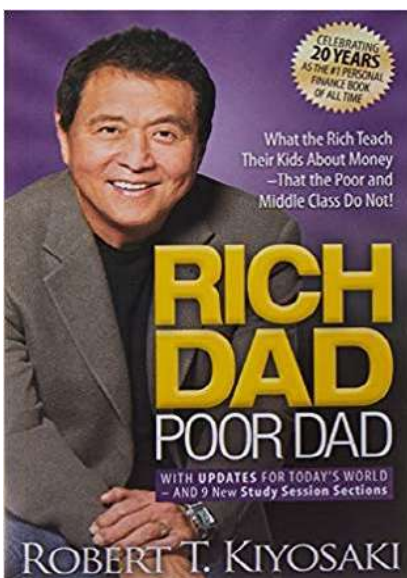
“Saying NO tells you that you know your limits”

- Mr. Ch Lenin Babu, Assistant Professor, Dept. of EEE

A Must read book

Rich Dad, Poor Dad

Rich Dad, Poor Dad by Robert Kiyosaki



On the complete other side of the spectrum, there's Rich Dad, Poor Dad.

Rich Dad, Poor Dad is to financial literacy what The Power of Now is to spiritual practice. It presents you with a complete set of sound, useful principles for living better and more effectively when it comes to money and personal finances.

The book uses the contrast between two characters, “poor dad” and “rich dad,” to teach various financial principles. The primary takeaway is that those who aren't good with their money and have less are that way because they work for money, whereas those who are good with their money amass more of it because they learn how to make money work for them. They're generalities, but the lessons taught are no less valuable.

If you want to improve your ability to manage your finances, Rich Dad, Poor Dad is the perfect package of enlightening knowledge and actionable instruction.



Once Buddha was in an assembly when a man walked in looking furious. He thought Buddha was doing something wrong. He was a restless businessman and he had found that his children were spending hours with Buddha when they could have engaged themselves in business at that time, making more and more money. He felt that spending four hours of their day seated next to someone whose eyes were always closed was incredulous. This was what had upset the businessman.

So, with furiousness walked straight up to Buddha looked him the eye and spat. He was so angry, he could not find the words to express them that he merely spat at Buddha. Buddha simply smiled. He showed no anger, though the disciples around him were angry. They would have liked to react but could not because Buddha was there. So, everybody was holding their lips and fists tight. After the businessman spat at Buddha and realized his action was not drawing a reaction, simply walked away in a huff.

Buddha did not react or say anything. He just smiled. And that was enough to shock the angry man. For the first time in his life, the man had met someone who would just smile when he spat on his face. That man could not sleep all night and his whole body underwent such a transformation. He was shivering, shaking. He felt as if the whole world had turned upside down. The next day he went and fell at Buddhas feet and said, Please forgive me. I did not know what I did. To which Buddha replied, I cannot excuse you!.

Everyone including the man and Buddhas disciples were flabbergasted. Buddha then explained the reason for his statement. He said, Why should I forgive you when you have done nothing wrong.

The businessman looked a little more surprised and told Buddha that it was he who had wronged him by spitting on him. Buddha simply said, Oh! That person is not there now. If I ever meet that person whom you spat on, I will tell him to excuse you. To this person who is here, you have done no wrong. That is real compassion.

Moral

Compassion is not saying, I forgive you. Your forgiveness should be such that the person who is forgiven, does not even know that you are forgiving them. They should not even feel guilty about their mistake.

We have to do is.....

If someone holds on to you for something you did in the past, just laugh at them. This is because you are not the same person now. You see it as though somebody else did it.

This is because the samskara of your consciousness has been erased, those things of the past have been erased. This makes you a new person, every time, every day. This is pure knowledge.

- Mrs. N Pushpa, Assistant Professor, Dept. of EEE

The war of currents and the search for truth

The decisive battle took place in 1893 at the Chicago World's Fair. On one side, the celebrated inventor Thomas Edison. On the other, his former employee Nikola Tesla.

And what were they fighting over – love, religion, territory? None of the above. They were fighting over alternating current (AC) versus direct current (DC).

A quick explainer: current in metal wires is the flow of electrons, pushed along by a voltage. If the voltage is sourced from a battery, the electrons flow in one *direction* only. We call this *direct* current, or DC.

However, batteries are not a primary source of energy. For that, we often use coal or natural gas. Their chemical energy is released in a furnace as heat to create steam that turns the shaft of a generator. In the simplest case, the shaft spins a magnet inside a coil and through the principle of electromagnetic induction produces an electric current. The polarity switches from positive to negative and back many times per second as the generator shaft rotates, thus the current *alternates* in direction. We call this *alternating* current, or AC. Even though the direction of the current alternates, its effects do not cancel out. The current does useful things in both directions, such as heating the wires in a toaster.

Starting in the late 1880s, Edison developed a cost-effective means of generating DC electricity, and a suite of related devices, including motors and meters to measure DC energy consumed. However, there was a problem. There was no way back then to convert the DC voltage to higher or lower values. To be safe for use in homes and factories, the DC generators were designed to produce electricity at low voltages. The downside was that this meant the losses during transmission from the generator to the consumer were high. Edison judged that to be an acceptable compromise, but it limited the distance between the generator and consumers to less than a kilometre or two.

In the other camp, Tesla had a secret weapon known as the transformer. It is a simple arrangement of iron cores and copper windings that allows voltage to be converted up or down. The limitation is that transformers only work with AC electricity.

With transformers, Tesla could boost the generator output to thousands of volts for low-loss transmission over long distances then cut the voltage down again to safe values for final delivery to the consumer.

There was a lot at stake, including patent royalties and the right to electrify the cities of the United States. The raging battle was called the War of the Currents.

Feeling the tide of battle swinging against him, Edison changed tactics and launched a misinformation campaign to argue that AC current was dangerous. To prove his point he arranged the public electrocution of stray dogs, cats and horses.

These skirmishes continued during the lead up to the Chicago event, till victory was declared for the Tesla AC camp. They were awarded the contract to electrify the Fair. From there it was all AC, with the definitive stake in the ground being the 1896 electrification of street lights in the city of Buffalo with AC power supplied from hydroelectric generators at Niagara Falls.

AC distribution of electricity has reigned supreme for more than 100 years. But a quiet insurrection is taking place in our midst. Our computers, machines, LEDs and electric cars all run on DC. And at the extremes of high power – distributing electricity thousands of kilometres from one region to the other – engineers have discovered that the losses from a million-volt transmission line are lower if it carries DC current rather than AC current.

Once again, the transformer is the secret weapon, but this time operating on DC. These new transformers take the form of electronic circuits that convert DC currents up and down the spectrum from a few volts to a million or more. Lighter and smaller than traditional ones, DC transformers make it easier to integrate wind and solar electricity into the grid, and they reduce the likelihood of failures cascading from one electricity generation region to another.

In the coming decades, we may see the DC insurrection take hold. Not through warfare this time – I predict no public electrocutions of stray cats. Instead, it will be a subtle, gradual process. But by the turn of the next century Edison may well have the final victory.

THE CURRENT WAR
THE TALE OF AN EARLY TECH RIVALRY

DC DIRECT CURRENT
The flow of electricity is in one direction only. The system operates at the same voltage level throughout and is not as efficient for high-voltage long distance transmission. Direct current runs through:
Battery-Powered Devices, Fuel and Solar Cells, Light Emitting Diodes

AC ALTERNATING CURRENT
Electric charge periodically reverses direction and is transmitted to customers by a transformer that could handle much higher voltages. Alternating current runs through:
Car Motors, Radio Signals, Appliances

THOMAS EDISON VS. NIKOLA TESLA

You would have never found two geniuses so spiteful of each other beyond turn-of-the-century inventors Nikola Tesla and Thomas Edison. They worked together—and hated each other. Let's compare their life, achievements, and embittered battles.

1847 BORN 1858

Milan, Ohio BIRTHPLACE Serbian, Croatia
Wizard of Menlo Park NICKNAME Wizard of the West

Home-schooled and self-taught EDUCATION Studied math, physics, and mechanics at The Polytechnic Institute at Graz

Mass communication and business FORTÉ Electromagnetism and electromechanical engineering

Trial and error METHOD Getting inspired and seeing the invention in his mind in detail before fully constructing it

DC (Direct Current) WAR OF CURRENTS: ELECTRICAL TRANSMISSION IDEA AC (Alternating Current)

Incandescent light bulb; phonograph; cement-making technology; motion picture camera; DC motors and electric power NOTABLE INVENTIONS Tesla coil; resonant transformer circuit; radio transmitter; fluorescent light; AC motors and electric power generation system

1,093 NUMBER OF US PATENTS 112

0 NUMBER OF NOBEL PRIZES WON 0

1 NUMBER OF ELEPHANTS ELECTROCUTED 0

1931—Passed away peacefully in his New Jersey home, surrounded by friends and family DEATH 1943—Died lonely and in debt in Room 3327 at the New Yorker Hotel

FALLING OUT
Edison promised Tesla a generous reward if he could smooth out his direct current system. The young and new took on the assignment and ended up saving Edison more than \$100,000 (millions of dollars by today's standards). When West asked for his rightful compensation, Edison decided to pay him. Tesla resigned shortly after, and the elder inventor spent the rest of his life campaigning to discredit his counterpart.

EDISON FRIES AN ELEPHANT
In order to prove the dangers of Tesla's alternating current, Thomas Edison staged a highly publicized electrocution of the three-ton elephant known as "Topsy." She died instantly after being shocked with a 6,000-volt AC charge.

WAR OF CURRENTS OFFICIALLY SETTLED
In 2007, East Edison opened 125 years of direct current electricity service that began when Thomas Edison opened his power station in 1882. It changed to only provide alternating current.

NOBEL PRIZE CONTROVERSY
In 1915, both Edison and Tesla were to receive Nobel Prizes for their strides in physics, but ultimately, neither won. It is rumored to have been caused by their animosity towards each other and refusal to share the coveted award.

Story Collected by:

Aragonda Bindevi

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II B.Tech EEE

In another intriguing project, researchers led by Peter Loutzenhiser are leveraging solar energy to reverse the combustion process and produce synthesis gas (mixtures of hydrogen, carbon monoxide, and small amounts of carbon dioxide), which can be converted into fuels such as kerosene and gasoline.

“Instead of using fossil resources to create fuel, we are using the byproducts of combustion (water and carbon dioxide) to re-energize the system with the sun,” explained Loutzenhiser, an assistant professor at Georgia Tech’s School of Mechanical Engineering.

The researchers are studying a two-step process using metal oxides that can split water and carbon dioxide. The first step, which occurs between 1100 and 1800 degrees Celsius, thermally reduces or “pulls off” oxygen from the metal oxide material. Then at temperatures of about 300 to 900 degrees Celsius, either water or carbon dioxide is introduced in the second step. These lower temperatures are favorable for re-oxidation, which enables the metal oxide to take back oxygen from either the water or carbon dioxide, resulting in hydrogen or carbon monoxide. “The two steps are important — otherwise the oxygen would recombine with either the carbon monoxide or hydrogen, resulting in the release of heat that would then be lost,” Loutzenhiser said.

The researchers have demonstrated that the technology works with zinc oxide, but they are searching for materials that can speed up the reactions and reduce the temperature of the first step. “You want something that can reduce at the lowest possible temperature in the high-temp stage and is capable of taking the oxygen from the carbon dioxide or the water vapor in the second step,” Loutzenhiser explained.

Recently, the group achieved promising results with mixed ionic electronic conducting materials. Now they are trying to tune these materials to break apart either the CO₂ molecules or the water vapor molecules at lower temperatures.

If commercialized, the technology could transform desert areas into fuel farms, Loutzenhiser said: “Instead of pulling fuel out of the ground, we could pull carbon dioxide from the air and use the sun to convert it with water into a long-term storage medium that could be shipped and used around the world without changes to transportation infrastructure.”

Researcher :

Dr. Peter Loutzenhiser

Associate Professor

Georgia Institute of Technology

Switzerland

Recent Inventions in the Electrical Engineering Industry

- Mr. G Dilli Babu, Assistant Professor, Dept. of EEE

High Efficiency Photovoltaic Cells

One of the enduring challenges of modern electrical engineering is to find an implementation of photovoltaic technology that is efficient, effective under varying operating conditions, and highly resistant to damage – while not being cost-prohibitive. Different engineering approaches have been used to raise collection and distribution efficiency, though perovskite-based cells have recently captured the most attention at major research facilities.

Green Energy Electrical Power Converter

Once you collect energy, converting it for use in the electrical system is an essential next step. A new power converter developed in the Department of Electrical Engineering at the University of Arkansas will now make it easier for users of renewable energy to shunt excess energy into the power grid. This has the potential to make rooftop solar initiatives much easier and to further incentivize homeowners to pursue energy efficient technology.

Smart Electrical Grids

As energy systems become more complex and energy sources become more diverse, smart grids are growing in importance worldwide. Smart grids integrate innovative electrical technology at multiple levels to improve flow control, detect malfunctions, and automate service delivery. With end-to-end communication between power plants, distribution sites, and the end user's electrical point-of-presence, it becomes possible to raise efficiency and reduce costs.

Virtual Reality

Virtual reality draws on multiple disciplines, but in terms of providing a sensory experience that maps effectively to "real life," electrical engineering is crucial. The earliest VR technologies consisted of a headset with gloves as an input device, rendering the user mostly stationary. Positional tracking is now making VR more interactive, but the market has yet to develop a solution using a complete array of sensors.

Eye Tracking Technology

As many consumers develop an adversarial relationship to conventional digital advertising, eye tracking becomes essential – not only to deliver commercial messages, but to better understand what information is of greatest interest. As it has matured, eye tracking technology has grown into an important frontier in accessibility for the disabled, allowing technology access through eye movement. Sensitive electronic sensors are the basis of virtually all eye tracking.

Wireless Wearable Tech

The idea of the "Personal Area Network" has been around in computing science for a long time, but it's only now becoming a practical reality. Devices can now operate on a smaller scale than ever and interface seamlessly with the wider environment. Wearable devices have been developed to authenticate access to vehicles and machinery, improve reading comprehension while engaged in exercise, and provide communications information without the use of a phone.

Graphene

As electrical engineers reach the performance constraints caused by the fundamental properties of matter, advances in materials science become essential. Graphene is perhaps the most important recent innovation. Graphene consists of a single layer of carbon atoms one million times thinner than paper. It's so thin that it is actually considered two-dimensional.

Graphene's unique characteristics make it the strongest known material on Earth. It can stretch by 20%, making it as pliable as rubber. It will provide immense gains in battery life for portable devices and is uniquely well-suited for wearable technology that collects biometric information from the user. In short, it may be essential to the future of electrical engineering.

Article-Student

As people rely more and more on technology to solve problems, the ability of humans to think for themselves will deteriorate

In today's modern era, many gadgets have come accessible to people all over the world. And, the technology has reached a whole new level in assisting mankind in every way possible, like, from telephone to the smart phone, from the gas stoves to the induction cook tops, from posting letters to sending emails, the technology has been evolving into better day by day to give the possible sophisticated surroundings to the human race.

It is making people's life easier and it is almost effortless to get a task done. So, in a way, it is certainly making people rely on it, in every possible way. And yes, I'd stand by the argument that the ability of humans to think for themselves will deteriorate. Is there anything on earth, that today's modern man can do without a machine? I don't think there are such things rather; the man wouldn't like to do all by himself. He wants things to be made simpler and easier and it is misconceptionally, "smart thinking".

Smart thinking and relying on the machines each time might seem the same. I'd rather say, they are two poles of a magnet. Smart thinking is getting best possible from the resources available. For example, to lose weight, consider two ways, 1. Going on a walk to a nearby park and 2. Buying a treadmill. In the example stated one can clearly differentiate the smart thinking and relying upon machines. Going on a walk to a nearby park would be called smart thinking because you get fresh air and better environment in addition. Buying a treadmill instead implies relying. Because, in relying, "comfort" gets focused. This relying might sound not important. But it further grows into negligence and man tries to think of alternatives for everything, which doesn't allow him to face the reality, which is not-so-good thing.



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Talent Hunt



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Bloom energy is changing the way the world generates and consumes energy. Our unique on site power generation systems utilize an innovative new fuel cell technology with routes in NASA's Mars program. It is derived from common sand like powder and leveraging break through advancements in materials science. This technology is able to produce clean, reliable, affordable power practically anywhere from a wide range of renewable or traditional fuels. Bloom energy serves or provides the most efficient energy and the planet providing for significantly reduced electricity cost and dramatically lowers green house gas emissions. Generating power on site, where it is consumed, bloom energy offers increased electrical reliability and improved energy security providing a clear path to energy independence.

The main source of Bloom Energy is the Bloom box or the bloom server in which it contains a solid oxide fuel cell .

Bloom Box or Bloom Server

It is a shiny box with solid oxide fuel cell made by bloom energy of Sunnyvale California. It can use a wide variety of inputs including liquid or gaseous hydro carbons produced by biological sources to generate energy on the site where it will be used. It can withstand temperatures up to 1800F (980C). That would cause many other fuel cells to break down or require maintenance. It is unlike usual batteries. It generates electricity using fossil fuels, which works like a battery but has a persistence source of fuel such as natural gas to keep the electricity flowing. It requires only one conversion i.e. from chemical to electrical. Our paper shows how to produce reliable, flexible, less polluting and continuous supply of electric energy from a cheap material i.e. sand which is available in plenty.

Working

A SOFC is a type of fuel cell valued for its potential market competitiveness, with high efficiency in fuel input and electricity output. A SOFC is like a rechargeable battery that always runs. It consists of three parts: an electrolyte, an anode, and a cathode. In Bloom's SOFC, the electrolyte is a solid ceramic square made from a common sand-like powder. According to Bloom's patent description, these thin white ceramic plates are Scandia stabilized Zirconium (ScSZr).

The Bloom server does not require chemicals, such as the corrosive acids used in conventional fuel cells. Instead, it uses inexpensive metal alloy plates for electric conductance between the two ceramic fast ion conductor plates, as opposed to the use of costly precious metals like Gold or platinum those are used for high conductance in other fuel cells. The electro- chemical process within SOFC requires a high operating temperature (600-1000C) for its reactions to take place.

At a high temperature, Warm air enters the cathode side of the fuel cell. The resulting steam mixes with the fuel to produce reformed fuel; this reformed fuel enters the anode side, and a chemical reaction takes place. As the reformed fuel crosses the anode side, it attracts oxygen ions from the cathode. Oxygen ions combine with the reformed fuel to produce electricity, water, and a small amount of carbon dioxide gas. Water is recycled into the cell to produce steam to generate reformed fuel, and this process also generates the heat required for the functioning of fuel cells. The continuous supply of fuel, air, and heat constantly generates the electricity from the cell.

Advantage

- Carbon Sequestration
- Reverse Backup
- Time to Power
- DC Power
- Hydrogen Production

Applications of Bloom Energy

- Bloom Energy can be used where the onsite generation of electricity is used.
- It can be used as a plug and play type of electricity.
- It can be used for all purposes like domestic and industrial.
- It is presently used by GOOGLE, WAL-MART, eBay etc.

Conclusion

The costs should come down over time to the point where Bloom boxes really can be used in homes. A Bloom home energy server combined with solar panels or some other renewable energy. Additionally it needs to be compared to other equivalent renewable technologies. plants. As stated in the technical information section, Bloom Energy has some advantages over other fuel cell companies primarily that they have been increasing their production rate over the past two years, and have a method to guarantee a continuous level of performance as the fuel cell ages. Going forward, other companies could easily have a better product than Bloom Energy.

The cost of a 100 kW Bloom Box has been previously stated to be between \$700,000 and \$800,000. This price is comparable to an equivalent installation of solar panels, which in 2005 cost the city of Oakland roughly 800 thousand dollar to have installed before any federal or state incentives. It is important to remember that a Bloom Box is able to produce constant electricity twenty four hours a day, seven days a week, unlike either solar or wind technologies. Although the Bloom Box costs significantly more, depending on a customer's particular needs it could certainly be a wiser investment than either 100 kW of wind or solar power.

On the other hand, a Bloom Box requires a constant supply of fuel, meaning it not only has a higher initial cost than wind; it also has an operating cost that is not present in either wind or solar electricity generation systems. In order to take this into account, the return on investment in each technology was considered. As previously discussed, the average ROI of an unsubsidized Bloom Box in California is slightly sooner than a wind turbine if run on natural gas, but much longer if it is being run on directed biogas. In both cases the unsubsidized Bloom Box has a better ROI than solar power. From a strictly monetary point of view, a Bloom Box appears to be the best option for commercial customers seeking to reduce their carbon footprint. Overall the Bloom Box has potential as an alternative energy source for businesses as long as the current levels of subsidies remain in place. Additionally the Bloom Electrons Service is an extremely beneficial program for consumers, but the economics of the current system do not seem much profitable.

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