SPARK INSIGHTS

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EXPLORING THE SPARK OF ELECTRICAL ENGINEERING

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EESoc

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WELCOME MESSAGE FROM THE HOD

Dear Readers,
It gives me great pleasure to welcome you to the new edition of "Spark Insights," the e-magazine proudly presented by the Electrical Engineering Society (EESoc) of the University of Moratuwa. As the head of the department, I am delighted to witness the success of this ambitious endeavour that showcases the remarkable ingenuity and enthusiasm of our budding electrical engineering undergraduates ably guided by its leaders. "Spark Insights" is not just a collection of articles; it is a testament to the innovation and dedication that characterize our institution. In these pages, you will find a treasure trove of knowledge encompassing diverse facets of electrical engineering.

Our vibrant undergraduate community has poured their energy into crafting articles that span the spectrum of our field: from Power and Energy, Power Electronics, Electrical Installations and Electrical Safety to Intelligent Automation with AI, where the boundary between human ingenuity and machine intelligence is ever more intriguing. One of the hallmarks of "Spark Insights" is its reflection of the dynamic activities organized by EESoc throughout the year. Our society, a hub of collaboration and innovation, has consistently orchestrated events that foster learning beyond the classroom.

Standing tall among student societies in all engineering faculties of the country, EESoc has taken the leadership to facilitate a meaningful transition from a state-owned electricity monopoly to a competitively operated electricity market in Sri Lanka. From workshops that push the boundaries of conventional thought to seminars that bring luminaries from the industry, EESoc has been instrumental in nurturing the holistic development of our students. As we stand at the intersection of tradition and progress, it is imperative to acknowledge the unwavering support of our faculty and staff, whose guidance propels our students toward excellence. The collaboration between mentors and mentees creates an environment where creativity flourishes and ideas find expression. I extend my heartfelt appreciation to the dedicated team behind the conception and execution of this e-magazine. Their passion and perseverance have translated into a platform that encapsulates the spirit of EESoc and the vibrancy of our department.

In closing, I invite you to delve into the pages of "Spark Insights" with curiosity and enthusiasm. May this magazine ignite not only sparks of knowledge but also a fervour for exploration and innovation. Together, we illuminate the path towards a brighter future powered by the intellect and imagination of the next generation of electrical engineers.

Warm regards,
Prof Anura Wijayapala,
Head of the Department,
Department of Electrical Engineering,
University of Moratuwa

SPARK INSIGHTS

WELCOME MESSAGE FROM THE PRESIDENT OF EESOC

Dear Readers,

The Electrical Engineering Society (EESoc) has played an instrumental role in several key junctures of the Electrical Engineering Industry of Sri Lanka. Our recent symposium on proposed electricity sector reforms was a major driving force behind initiating a much-needed intellectual discussion on the topic. How EESoc, a student-led and student-based society, was able to inspire many professional organizations and societies to organize similar events, which eventually facilitated the reforms to be looked at and discussed not just from the electrical engineering perspective but also from financial, social as well as political has been a topic of discussion.

Apart from being involved in the critical recent developments in the industry, EESoc also plays a vital role in developing unity among the university student body by organizing student events throughout the calendar, such as Prakampana – talent show and Cricket-fiesta, the intra-department cricket tournament. Community projects uplifting the lives of the society, such as We-Are-With-You for the school of the deaf and Sipdarana for renovating less facilitated rural schools, are also popular and highly acclaimed events in EESoc's annual calendar.

Sparks Insights magazine is another similar ideology ignited within EESoc, which has been made a reality by an enthusiastic and hard-working group of individuals. I sincerely appreciate the editorial team's extraordinary effort in collecting, screening, fact-checking and proofreading articles before compiling them into a well-formatted and attractive document. This magazine aims to provide a platform for students, academia, and industry professionals to share and discuss the latest developments in the industry locally and globally. Our editorial team ensures the articles featured in our magazine are written in simple language and can be understood without a deep knowledge of the subject.

For students who are hoping to step out into the industry soon, Sparks-Insight is an ideal tool to keep their general knowledge of the industry up to date and make themselves more visible. Therefore, I invite all stakeholders of the electrical sector to join hands with sparks-insight and EESoc and help to drive our sector to greater heights.

Warm regards,
Dr Manuja Gunawardana,
Senior lecturer,
Department of Electrical Engineering,
University of Moratuwa
President, Electrical Engineering Society (EESoc)

WELCOME MESSAGE FROM THE SENIOR TREASURER OF EESOC

Dear Readers,

Heartfelt congratulations on the momentous occasion of the release of "Sparks-Insights" magazine! Your unwavering dedication to the advancement of electrical engineering students at the University of Moratuwa is truly inspiring. EESoc has long been recognized as a cornerstone in the educational journey of budding engineers, providing a nurturing environment where both career growth and personal development thrive.

The society's commitment to organizing impactful events goes beyond academic enrichment; it embodies a holistic approach to grooming well-rounded individuals. From symposiums on proposed electricity sector reforms to talent shows like Prakampana, department cricket tournaments to community service initiatives like We-Are-With-You and Sipdarana, EESoc continuously fosters teamwork, leadership, and social responsibility among its members.

Furthermore, the organization's initiative to organize several seminars and workshops on leading research topics, such as Artificial Intelligence, battery research, and more, demonstrates its commitment to staying at the forefront of technological advancements. These platforms not only provide valuable insights into emerging trends but also foster a culture of continuous learning and innovation among students and professionals alike.

"Sparks-Insights" magazine serves as a testament to the society's dedication to promoting knowledge exchange and collaboration within the electrical engineering community. By providing a platform for students, academia, and industry professionals to share insights and discuss the latest industry developments, the magazine not only enriches minds but also fosters a sense of belonging and camaraderie among its readers.

As you celebrate this milestone achievement, remember the profound impact that EESoc has on shaping the future of electrical engineering. Your collective efforts not only empower current students but also leave a lasting legacy for generations to come. Here's to the continued success of EESoc and "Sparks-Insights," and may your endeavours continue to illuminate paths for aspiring engineers worldwide.

Warm regards,
Dr Logeeshan Velmanickam,
Senior lecturer,
Department of Electrical Engineering,
University of Moratuwa
Senior Treasurer, Electrical Engineering Society (EESoc)

SPARK INSIGHTS

WHAT IS EESOC ?

The Electrical Engineering Society (EESoc) at the University of Moratuwa stands as a vital community within the Department of Electrical Engineering. Established on October 21, 1994, under the guidance of Prof. Rohan Lucas and Prof. Samarajeewa Karunaratne, EESoc has evolved into a dynamic force, contributing significantly to the academic and creative landscape of the university. The society's mission centers around enhancing leadership skills and promoting social awareness among its diverse membership, including undergraduates, academic staff members, and beyond.

EESoc is more than just a society of the Electrical Engineering Department. It's like a team that works closely with the department to help undergraduates not only become skilled in technology but also develop as well-rounded individuals. The society's main goal is to improve leadership skills and make undergraduates more aware of what's happening in the industry.

At the heart of EESoc's objectives is the dedication to nurturing young engineers as future leaders in the field of Electrical Engineering. This vision encompasses contributing positively to society while championing ethical practices. The EESoc consistently organizes projects, showcasing its dedication to academic growth and technological awareness. These initiatives reflect EESoc's commitment to producing engineers who excel not just in technical expertise but also in ethical and leadership dimensions. Through events like Sip-Darana for underprivileged O/L students, We Are With You, an annual charity program, Tech Talk sessions on cutting-edge topics, and the vibrant showcase Prakampana, EESoc stands out in fostering academic growth, technological awareness, and artistic talents. This essential society at the University of Moratuwa leaves a lasting impact on both academic and cultural landscapes.

EESoc, as a driving force behind numerous successful events, has become an indispensable and influential society within the University of Moratuwa. By leaving an indelible mark on both the academic and cultural landscape, EESoc consistently proves its importance through a diverse range of impactful initiatives. It provides an open arena for undergraduates, creating an environment where individuals can thrive academically and creatively. In essence, EESoc is not merely a society; it is a community that shapes the engineers of tomorrow, fostering innovation, honing talents, and instilling a sense of social responsibility in every undergraduate.

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EESOC EVENTS






DEPARTMENT CRICKET TOURNAMENT

The Department of Electrical Engineering's Intra Batch Cricket Tournament commenced on October 12th, 2023, on a bright and sunny day at the University Grounds. Teams representing batches 19, 20, 21 and the staff enthusiastically participated, creating a charged atmosphere filled with excitement. Throughout the matches, players showcased their skills while spectators cheered them.

After a preliminary round of matches, the final match between Batch 21 and Batch 20 took place, with Batch 20 emerging as the overall champion. The day concluded with an award ceremony, strengthening bonds and sportsmanship among students and staff and providing a refreshing break from the daily routine.

As the sun set, the energy shifted from the cricket field to the Sumanadasa Open area for an epic DJ party. The party provided a perfect opportunity for students to relieve stress. With laughter and music, the event not only served as entertainment but also as a means to enhance interpersonal relationships within the department.





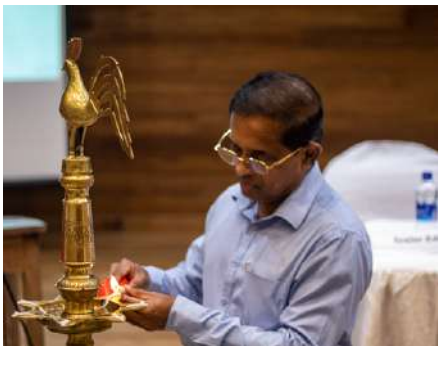
ANNUAL GENERAL MEETING

The annual general meeting of the Electrical Engineering Society at the University of Moratuwa was successfully convened on September 13, 2023, at the Rubet Peiris Auditorium, with the participation of undergraduates from 19,20 and 21 batches. The event commenced with the traditional lighting of the oil lamp, followed by a welcoming address from Dr. Manuja Gunawardana.

Next, it was a speech by Prof. Anura Wijeyapala, emphasizing the significance of extracurricular activities and the importance of soft skills for engineers navigating today's society. The meeting proceeded with a recap of the activities from the previous AGM in 2022, presented by the outgoing secretary, Ms. Dulja Bamunusinghe, followed by financial updates from the outgoing junior treasurer, Mr. Lakshitha Liyanage, and a report on past term activities from the outgoing Vice President, Mr. Pankaja Senevirathne.

Following these reports, elections were conducted for the executive committee of the upcoming term. Dr. Manuja Gunawardana and Dr. V. Logeeshan were re-elected as President and Treasurer, respectively, for the new term. Mr. Chasila Withanage and Mr. Manula Thennakoon were elected as Vice Presidents, while Mr. Sasika Prasad and Mr. Risinu Munasinghe assumed roles as Secretary and Junior Treasurer, respectively.

Certificates of appreciation were distributed to participants of Sip-Darana, EESpire 23, and the National Symposium on Power Sector Reforms in Sri Lanka for their dedicated contributions to the success of these events. The audience was treated to captivating performances from the 20th and 21st batches, showcasing their talents and creativity, adding an artistic flair to the proceedings. To conclude the event, the newly elected secretary delivered the vote of thanks.



EESPIRE '24

EESpire'24, the official career fair of the Department of Electrical Engineering at the University of Moratuwa, was successfully held on 20th February 2024. This year marked the fourth consecutive year of the event, offering the 19th batch of undergraduates the opportunity to take their first steps into the professional world. The event was organized by the Electrical Engineering Society of University of Moratuwa, supporting students in their transition to the professional world.

The career fair featured a series of sessions aimed at preparing undergraduates to face the industry confidently. Mr. Arjuna Jayadarshana, Technical Services Manager at IPD Colombo, shared practical guidance and tips, offering valuable insights for navigating the industry effectively. Additionally, Ms. Kalani Collure, HR Manager at South Asia Gateway Terminals, conducted a session on career development and growth, providing valuable advice on building a successful career and excelling in the industry through her expertise.

EESpire'24 featured the involvement of many top companies, presenting a variety of career paths for the participating undergraduates. The event offered students valuable opportunities to explore different career paths, learn from industry experts, and connect with top companies. EESpire'24 demonstrated the department's commitment to preparing students for the professional world by equipping them with the skills and knowledge needed to succeed in the field of electrical engineering.

FORUM ON "REFORMS FOR A SUSTAINABLE POWER SECTOR FOR THE NEXT GENERATION"

The Electrical Engineering Society at the University of Moratuwa recently organized a forum titled "Reforms for a Sustainable Power Sector" in collaboration with the IEEE Power and Energy Sri Lanka Chapter. It was held on December 21, 2023, at Hotel Galadari, with the aim of exploring innovative solutions for the power sector.

Professor Anura Wijayapala warmly welcomed all participants in his opening address. Then, as the first speaker of the day, Engineer Nihal Wickramasuriya provided a brief overview of electricity reforms in Sri Lanka, dating back to its inception in 1895 by private companies in Colombo. He highlighted how government regulations evolved over time, notably through amendments to the Electricity Act 19 of 1950 and comprehensive studies conducted in 1993 and 1996/1997.

Professor Asanka Rodrigo delved into various reform models, discussing different market structures and challenges in formulating a national electricity policy. He emphasized the importance of long-term planning for the power sector's growth. Professor Lilantha Samaranayaka shared insights into power sector models from around the world, focusing on the South Korean model and its successful resolution of operational challenges.

Dr. Tilak Siyambalapitiya examined the efficacy of proposed draft acts in addressing power sector issues, particularly concerning consumer concerns such as electricity costs, comparing them with other Asian countries. Engineer Pubudu Niroshan highlighted key considerations, elements, and proposed policy adjustments.

Finally, Dr. Manuja Gunawardana concluded the session with a vote of thanks, acknowledging the contributions of all speakers and participants.

WE ARE WITH YOU

The "We Are With You" charity event, organized by the Electrical Engineering Society (EESoc) of the University of Moratuwa in collaboration with Manusath Derana, has made a resounding return on 21st March. After a temporary pause due to the global pandemic, this annual programme, with a rich history spanning two decades, once again aims to create moments of joy, togetherness, and crucial support for the students of the School for the Deaf in Ratmalana.

In its inaugural phase, generously sponsored by Manusath Derana and SPAR Supermarket, the event focused on providing essential sustenance, such as food, to the students of the deaf and blind schools of Ratmalana. Beyond nourishment, the organizers ensured a touch of celebration with a unique entertainment segment presented by talented students from the Deaf school. Speeches by esteemed guests and organizers conveyed messages of solidarity and support, setting the tone for the event's compassionate mission. Notably, Mr.Manula Thennakoon, the vice president of EESoc, delivered a heartfelt welcome speech reaffirming the collective dedication to the cause. Additionally, speeches were delivered by a teacher representing the Deaf and Blind schools, as well as a representative from Manusath Derana, further emphasizing the importance of unity and support within the community.

Looking forward, anticipation mounts for the second phase of the event, scheduled for the end of April. This phase will shift its focus towards providing hearing aids to the students of the Deaf school, further enriching their lives and fostering a sense of inclusion and empowerment. Building upon the success of its inaugural phase, the "We Are With You" initiative continues to uphold values of compassion and support, demonstrating a commitment to reviving hope and promoting inclusivity within the community.

TECHtalk Generative AI has Swallowed the World, Now What?

The Electrical Engineering Society of the University of Moratuwa organised a tech talk titled "Generative AI has Swallowed the World, Now What?" on November 28, 2023, as part of Prof. Jason Mars' visit to the university. Prof. Jason is a visionary computer scientist specialising in generative AI and the founder of Jaseci Labs. The session welcomed not only undergraduates from the Department of Electrical Engineering but also all AI enthusiasts at the University of Moratuwa.

The seminar room at the Electrical Engineering Department was packed with young enthusiasts by 4 p.m., eagerly awaiting the session. The event commenced with the lighting of the traditional oil lamp, followed by a welcoming address from Prof. Anura Wijayapala, the department head.

During his session, Prof. Jason delved into topics such as language models, their significance in the world, their future, and how they operate to achieve their objectives. Furthermore, he elaborated on the concept of "no code" and highlighted the importance of mastering basic theories to safeguard one's career against the advancements in AI. His presentation was engaging and lively, with humorous anecdotes interspersed throughout. Certificates were awarded to participants who successfully completed an AI course during the session, followed by a thank-you speech from Dr. Manuja Gunawardana.

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THE SPARK OF EXCELLENCE

THE JOURNEY OF

Mr Nadeera Wijesinghe

Discover the inspiring journey of Mr. Nadeera Wijesinghe, who graduated from the Department of Electrical Engineering, University of Moratuwa in 2007. He is now a chartered Electrical Engineer by profession, the founder/ CEO of Vibhawa Consultants and the co-founder of Noblekey. He is also a level 3 certified infrared thermographer and a trained power systems simulations engineer who also mentors young engineers to grow in their careers. He received the Engineering Excellence Award for Excellence in engineering journalism in 2019.

Can you elaborate more about your academic journey starting from an undergraduate level?

If I talk about my academic journey from the university level, I was not that brilliant in academics. I graduated with an overall GPA of 3.29, merely missing the 2nd upper class. Something worthwhile noting is that I used to spend around 15 to 30 minutes in the library after the practical sessions in a lab to understand more about laboratory practices, whether I understood them or not.

Talking about sports and games, I was a university colours man. I was in the university swimming team from the 1st year, and I was the captain of the university swimming team during my final year. Our team has won university championships twice in the men's category. I was a vice president of EESoc and a secretary of the university sports council.

I am one of the very few level 3 certified infrared thermographers in Sri Lanka. I completed my master's in energy systems. I am also a project management professional (PMP) in good standing since 2013. I have been trained to do power systems simulations using the ETAP electrical software. I worked as a demonstrator for the laboratory practicals at the electrical department for level 1 and level 2 students before passing out from the university.

What motivated you to choose the Department of Electrical Engineering as a major?

That is an interesting question. I will share a small story with you. When I was doing A/Ls in my school, there was a tuition teacher who was said to be the best at teaching the chapter on electricity. To grasp this chapter, I attended that class from beginning to end. But I never understood even a small part of it. After that, I thought I would never learn electrical theories. I marginally missed the engineering faculty in my 1st shy of A/L. In the 2nd shy, I got selected to UOM in the merit list. When I came to the University of Moratuwa, I was initially planning to do chemical and process engineering. In the first year of my university, we were taught the theory of the electricity module. Only then did I understand the theories. This newfound understanding, coupled with my enduring passion for science, sparked an interest in Electrical Engineering. And when I went to the electrical labs, I felt that electrical engineering suited me well.

We have various projects in our curriculum. What was the most impactful project or course that shaped your learning experiences during your undergraduate years?

I liked the power systems protection module even though my grade wasn't excellent. I used ETAP software to do the simulations for the protection of power systems for many projects after passing out from the uni. Honestly, during my uni days, I never thought I would do such extensive protection studies. Also the module theory of electricity, I still refer to those notes whenever needed. I advise the undergraduates that when they go to the field or to the industry, they should always stick to the basics they studied. In addition to these foundational modules, my Final Year Project was another defining experience. My Final Year Project was developing a sensorless controller for a brushless DC Motor, which was an interesting project in which I gained knowledge in many aspects.

You were the vice president of EESoc, captain of the swimming team and the secretary of the sports council. Can we get insights into how those experiences contributed to your personal and professional development?

In our days, we used to have the Annual General Meeting (AGM) and the panel discussion of EESoc as grand events at the BMICH. Securing sponsorships from various companies was a crucial part of the organization process. So, during this process, the director board or the company's senior management used to ask many questions, such as why we should give sponsorships, etc. It forced me to hone my communication and persuasion skills while giving me invaluable insights into how senior management thinks and makes decisions. Being a vice president of EESoc helped me to maintain a fine balance between the academic staff, batchmates, juniors, industry, and sponsors. It helped me to become who I am today.

Leading the swimming team presented a different challenge. Without a pool on campus, practices meant hour-long commutes. Sometimes, the university games come in the way of semester exams, but I maintained a balance between extracurricular and academic activities. I rarely missed lectures.
What I learned from extracurricular activities is how to create a balance with your work, family, and friends. It's very important when you enter the industry and when you pursue your life.

Stress is a common term among university students nowadays. Did you face any challenges as a student during your undergraduate life, and how did you overcome them?

Stress will always be present for an undergraduate, and most importantly, each person should have a coping mechanism. You should take care of yourself both physically and mentally. If you are not physically active, your brain will degrade faster. It will eventually increase your stress. When you have health problems, whatever the money you have, whatever the positions you hold if you have not taken care of your physical well-being, you will ultimately end up getting more stressed. I didn't prioritize my health after I graduated (because I thought I was so healthy and no need to worry about that). When I turned 29, I realized that I had neglected my health significantly, and then I worked on improving that aspect. I want to emphasize the importance of taking care of your physical well-being. When I look back after becoming a person in his forties, I have seen many have failed in maintaining physical well-being - then your other achievements will not be relevant. You will have no way to enjoy what you have achieved if you can't be fit enough.

If you are stressed and cannot handle it alone, you should consult a psychologist. There is no shame in that. Always don't be shy about seeking help from others. Another important tip I would like to share is always have a hobby for yourself. It lets you switch off your brain from the fast-paced work life. I really enjoy swimming, but

swimming is not a hobby. A hobby typically has two characteristics. Firstly, it should provide mental pleasure without any tangible return. Secondly, it should genuinely engage your mind.

How did you manage your time to do extracurricular activities without affecting your academic performance?

You should try to manage your energy, not time. Trying to manage your time won't work much. We should always keep in mind that you can't be better at everything. Even a successful person will have weaknesses in certain areas. One might be excellent in sports but weak in academics. It is normal, and you should accept it. When you put so much into one area, obviously, you will have some weaknesses in other areas. So, we should have a balance on how much of our energy we should be giving to every related area.

> **"You should try to manage your energy, not time.**

Can we get insight into your career journey, from your internship experience to managing your company?

Talking about my work, I did my internship at Shin Nippon Air Technologies, and I was involved in the Triton hotel refurbishment project, which is now known as Heritance Ahungalla. I am the first electrical engineer of Sri Lanka's first-ever privately managed industrial zone, the MAS Fabric Park Pvt Ltd, and was involved in the medium voltage distribution network there. I was responsible for the electricity distribution inside the MAS Fabric Park. I have renovated a 45-year-old generator with my team, which was meant to be sent for scrap. Everyone warned me to keep my hands off it, even when I contacted a German company; they also said they could not help as the technology was outdated. With the help of the technicians on my team, we collected spare parts and renovated the generator successfully. I worked in the fabric park for five years before joining Holcim Lanka in 2012 as a Project Electrical Engineer. At Holcim, I headed the electrical-related activities for the entire Holcim's largest capital expansion - the RCW Roller Press Project in Galle.

After that, I went back to MAS Active Linea Intimo. I worked there as an Assistant Manager - Sustainability for two years. The one significant project I have done there was conceptualised, initiated, and led the world's first chemical leasing project in wastewater management. I was asked to present this project at the sustainable chemistry conference in Berlin in 2015. I was the only non-chemical person to present a case study there. We have won the Presidential Green Award for the sustainability projects we did.

Then, I went to Qatar and worked as a senior Electrical Engineer-designer for M.A. Consultants. One of the interesting projects I did was modelling the entire medium voltage network of the Lusail stadium, where the FIFA World Cup 2022 final game took place. I was in Qatar for three years before returning to Sri Lanka and starting my company, Vibhawa Consultants. I started it as a one-man company with one electrical tester, which I carried by hand from Qatar. Now, we have a full set of electrical tester banks to cater to almost all the testing in medium voltage & low voltage systems. Now we are one of the leading companies who is doing electrical testing from low voltage to high voltage. We usually do ETAP power system simulations for Sri Lankan and overseas clients. For the past 3 years, I have been working on the USAID Sri Lanka energy program as the Technical Lead. My designation in that project is as the lead for power systems, tariffs, and demand-side management.

> **Learning is a lifelong journey. There will always be a lot to learn by yourself.**

You started your first job at MAS, what are the specific strategies you used to adapt from university to the workplace environment?

Before going for a company, you should first understand that everyone has a specific role in making the company run. So, you should show respect for each role. Don't get into your head that you are an engineer. You should develop an excellent professional relationship with everyone in the company, from the security guard to the tea-making lady. It will help you in your long-term career.

Also, don't mix up your work and play. Your work and play should be separate. Another important aspect is that you should be focused on your scope and know your boundaries but always be willing to help your colleagues. I would like to add that you shall always be willing to learn, even after you have passed out from your university. Learning is a lifelong journey. There will always be a lot to learn by yourself.

What inspired you to start Vibhawa Consultants from your academic journey?

I had come to a point where it was enough working for others for so long, and I wanted to do something by myself. Also, I developed a passion for electrical testing and electrical simulations. What inspired me was when I went to Qatar, I had this plan to earn a capital reserve so that I could survive a period without a salary and come back to start a consulting company. There was a gap in electrical testing and condition monitoring in the Sri Lankan market, which I wanted to meet. When I started the company 5 years back, I didn't think we would go this far now. It has been a challenging journey but an enjoyable one.

Technology is growing at a speedy rate in the world today. What do you see with the current trends and the emerging technologies in Electrical Engineering that the undergraduates should be aware of?

Let's consider about thermography. Thermal cameras are emerging like nothing. The thermal camera we are using now is not the same one we used 4 or 5 years ago, but the fundamental physics behind that never changes. The power systems simulation software I have now on my laptop is very different from what I had 7 years ago, but the fundamental physics behind all these things never changes. Technology changes, but you can adapt to new technology if you know its fundamentals. I advise young graduates always to learn the fundamentals by heart. You can analyze many complex problems using the fundamentals. The weakness I see nowadays in recent graduates is that many do not understand the fundamentals. But many of them know all the advanced equations and calculations. When you ask a fundamental question, many struggle to answer. So, always understand your fundamentals. Then, you can always keep up with the current technologies.

Moving towards the current professional experience, can you highlight some of the unique challenges or opportunities you have encountered in the industry?

When you have a challenge, there is an opportunity. During the economic crisis, many companies shut down, and some of the professionals & company owners migrated. So, always be patient during challenging times. There will be a good time coming. When I started the business, I saw that the electrical condition monitoring was not happening well. I have seen these electrical fires emerging in many buildings. When you see a problem, you can always have a business opportunity. In the industry, you should never run away from problems. You should find a solution to that problem, and then there will be a career as well as business opportunities. If everything is fine, there is no need for high-performing people.

Remember, "When the going gets tough, tough gets going."

As a successful professional in the field of Electrical Engineering, what would be your advice to our current Electrical Engineering undergraduates?

The first one is understanding your basics and the fundamentals. The second one is when you go to work, put effort into developing your personal brand. The third one is don't compromise on the values you have. For example, say you are a non-alcoholic person; whoever comes and tells you, don't compromise on that value of being non-alcoholic. The values you have will define you. Another piece of advice is not to mix your work and play. You will understand these things in depth when you go to work.

> **Be passionate about the work you are going to do - whatever it is or whatever the field.**

Before we conclude, are there any additional insights you would like to share so that our current undergraduates will benefit?

I want to tell you that you should enjoy your undergraduate time the most as it will not come back again. You all have great potential to contribute to the country and the world. Be passionate about the work you are going to do - whatever it is or whatever the field. When you are doing something, ensure you deliver something you want to receive.

On a final note, if you have to summarize your university life in 3 words. What would that be?

- Fun
- Adventurous
- Reinventing myself

THE JOURNEY OF *Mr Dehan Vithana*

Explore the inspirational journey of Dehan Vithana, Manager of Data Science and Analytics at MAS Intimates. He is a dynamic person with a passion for bringing about change and adjusting to new situations. He is a proud graduate of the University of Moratuwa's Department of Electrical Engineering. He takes pleasure in imparting knowledge and insights to Sparks that he has acquired over the years.

Can you tell us what inspired you to choose electrical engineering as your major? Were there specific reasons or influences that led you down this path?

Choosing what to study in college is important. Most people think about getting a job that pays well, but I had a different idea. I wanted to pick something where I could do well in academics and also have fun outside of them. Back then, life seemed simpler, and I wanted the full university experience. Things were different than I had hoped once I joined the electrical engineering department. We didn't just stick to one thing. We learned about multiple engineering disciplines, including computer science, electronics, civil engineering, mechanical engineering, etc. While students in other departments were buried under piles of books, we managed to enjoy our time at university while still doing well in our studies. Finding that balance between doing well in classes and enjoying everything else the university has to offer is important.

Did you know the curriculum before coming to the department?

I wasn't very interested in academics when I first started university. My motivation for choosing engineering school was to obtain practical experience, understand how real-world processes operate, and improve soft skills that would set me apart in the corporate world. While I was aware of the value of having an engineering degree, I also realized that professional and soft skills are more important. I knew a little bit about what to anticipate from Electrical Engineering. I had no idea how complicated it would all be until I entered the CEB for my internship.

How did the transition from undergraduate to employee happen?

I had many different experiences while studying electrical engineering, which changed how I viewed the topic. My journey started with internships, which I completed first at CEB, where learning was concentrated, and then at Unilever, where I was thrown into the deep end of practical work, managing technicians and solving real-world problems. The turning point was when I worked with close friends during my final year project titled "Reduction of Solar PV Payback Period Using Optimally Placed Reflectors". Our Team was able to create a model that was recognized by several international conferences. This project gave me a spark for my career goals. My involvement in extracurricular activities played an important role in my career path. It went beyond just improving my resume; It opened up new opportunities and allowed me to explore interests beyond electrical engineering. Once in the industry, my focus shifted to developing mathematical models for effective decision-making in business operations. This experience honed my business skills and gave me valuable insight into business. Over time, I became actively involved in innovations such as Industry 4.0 and smart factory concepts.

Mr. Dehan, as per our information, you have held numerous leadership positions in your university life. Can we get an insight into those, and how did these experiences contribute to your personal and professional growth?

In our standard university courses, we delve deeply into concepts and details. But things get very different when you enter the corporate world. All of a sudden, everything revolves around working with people: networking, managing, and negotiating. You may occasionally find yourself having to translate complicated technical concepts for people who don't speak the same language. Additionally, the boss may occasionally be a manager from finance rather than from a technical background. At that point, you understand how crucial it is to translate your technical expertise into plain language that anybody can understand. You don't learn about this in your typical classes. It's something you learn from working with people from various backgrounds in the real world. You constantly interact with people from different departments and faculties, whether you're playing sports, working on projects together in societies, or just hanging out. When you go into the corporate world, that diversity is quite valuable. If you're thinking about continuing your education after graduation, then things change a little. It is less about managing personnel and more about managing projects and research materials. Even so, having those soft skills is essential, and developing them can lead to opportunities you never would have thought possible.

Shifting to the present, what do you see as current trends or emerging technologies in electrical engineering or data science fields that students should be aware of?

Data Science has 3 main domains to study. Business domain, programming fundamentals and statistical knowledge. Dealing with the programming domain and statistical domain is much easier, as taught at the university, but dealing with the business domain is a difficult task. There, you are going to identify a problem and find a solution to it using mathematics. So, understanding the business domain is very critical. What I see is the people from the faculty of engineering are struggling to align with the business domain. I think the curriculum should align with the emerging technologies integrated with Business Models.

When talking about emerging technologies, one would be GenAI. It is used to automate supply chain processes and manufacturing processes. In smart grids, generative AI can also balance the grid. You need to know how grid balancing works to build that kind of AI. That's where the business domain comes in.
IoT (Internet of Things) is another emerging area that is not directly connected to data science. Especially in my area, in order to manufacture garments we need a significant amount of data on identifying how to manufacture the best garment within a shorter lead time. It is a tough task if we have a person to enter data manually. Sometimes, it takes a lot of time to collect data. That's where IoT comes into play. We automate data capturing points, run different machines on IoT, collect data, put it into a database, and then use that data for data science models.

The third one would not be a technological but an ethical application. With technology coming into play, privacy concerns are there, and how you use data is another concerning area. Cambridge Analytica used data from Facebook for its data manipulation purposes. From that point onwards, people started to raise concerns about data privacy. Sri Lanka recently passed an online safety bill, and we also have a data protection bill. Those have their own pros and cons, but they mainly focus on protecting one's data.
I can include Blockchain as an emerging technology. Even for the transmission of current through transmission lines, people use blockchain technology to identify optimum transmission schemes. After the pandemic, people are looking into ways to minimize waste, and because of that, blockchain comes into play to optimize some of the supply chain principles.

> **This incident also taught me a great lesson about how important it is to learn from your mistakes.**

Can you share insights from any internships or industry placements you had during your undergraduate years? How did these experiences influence your understanding of the electrical engineering field or the industry that you are currently involved in?

Both CEB and Unilever taught me how to break down a complex problem into smaller ones. We recalled the lessons from previous semesters, while we studied and listened to others in CEB. However, I didn't know how the application works in real life before the internship so gaining knowledge on both theoretical and practical applications is important. The same applies to my current position. Understanding AI and machine learning algorithms is one thing, but putting them to use in practical situations is completely different. A different strategy is needed to convert them into a business application.

My initial learning experience was at CEB, where I gained invaluable experience that provided me with advanced knowledge. Looking back on my time at Unilever, I gained the ability to take on responsibility. During my time at Unilever, I was given the task of designing a drawing of a substation that was located inside the production facility. My initial task involved going through all the parameters and catalogs, followed by the actual design work using AutoCAD. Even though it was a big task, I finished it within a month. The second example involves an earthing project at Unilever, where I had to replace and recalibrate earth rods for fiber optics. I was given the responsibility of leading a team of 5 or 6 technicians, which required me to step out of my comfort zone because they were older than me. I've had to guide individuals who are older and more experienced than me in certain recent business situations.

During my time at Unilever, I made a mistake that led to a fire in the factory. I had to go through a number of audits and investigations as a result of this incident. But this incident also taught me a great lesson about how important it is to learn from your mistakes. These things highlight the importance of internships. yet its duration is limited to six months. Learn as much as you can from the internship.

Are there any challenges you faced as a student, and how did you overcome them? Additionally, are there specific skills or knowledge gaps you identified during your undergraduate years that you addressed later in your professional life?

As a batch representative, I worked with people from many backgrounds. During that time, there were internal conflicts among students, often based on geographical differences. However, both fresher's night and sports day were started at that time. Managing people was the most challenging task during that period.
In terms of academics, we had to balance other extracurricular activities with learning a lot of content in a short amount of time. I stopped doing any other job to make the most of my 24 hours of study time during the reading week since it was difficult to fully understand the theory in a shorter amount of time.

Time management was not a big issue for me because I lived in a boarding home. However, finance was a big struggle.
I received Mahapola based on merit, and during my last year, I earned a salary from an outside company, which helped me cover the majority of my costs. Since I was the batch representative, I was able to help friends in need by reaching out to donors on their behalf. We also had certain political concerns to deal with, which the administration eventually resolved. My university experience was a mix of academic challenges and other problems I faced over the four years at the university.

> **"I recommend that you have a mechanism where you need to prioritize.**

Can you share any strategies you used for effective time management throughout your academic career?

During my undergraduate years, the only thing I had to do was to reduce my sleeping time. That's the only way I had to manage my time. There were days I slept only for 2 or 3 hours, and there were days I didn't have any time to sleep as well. There was continuous work some days. I don't recommend it since sleep is mandatory. What I recommend is that you should have a mechanism where you need to prioritize. Try to find which one is the most important and which one can be neglected. For example, there were some mathematical models that I didn't spend much time on after learning them. I understood them in lectures and managed them in the reading week. But there were some modules I had to spend a lot of time learning. This method helped me manage my academic stress.

In our third and fourth years, we divided the lessons among friends in our boarding house. After finishing, we shared what we had learned with each other. That's how we managed our workload when time was limited. If there are tasks you can cut off, just go ahead and do so. If you find yourself unable to balance academics and extracurricular activities, prioritize academics and let go of the extracurricular activities. I had to make tough decisions, like resigning from leadership roles, to manage my workload. Sometimes, making these decisions is necessary to reduce stress.

Can you share with us how that shift happened? Were there any barriers or challenges you encountered during this transition? And what motivated you to choose and change your path to the data science sector?

During that time, the concept of data science was not popular. I initially worked at the Sustainability and Talent Analytics Institute because my final research focused on solar and renewable energy, aligning with their sustainable energy initiatives. In my workplace, we undergo 360 evaluations, which include skill assessments and discussions about available career paths. After about 6 or 7 months, they proposed a new career path for me, which was in data science. It was a tough task, a completely new role with only 3 or 4 people included in that career path. That's how my transition happened.

They supported me through the learning and training programs. Then, I realized I could explore more. Unfortunately, I had to give up some of the things I learned in electrical engineering because concepts like power generation do not apply in data science. However, there were scenarios where I helped friends at the university in different fields to solve problems. The principle that applies in engineering is building a reliable and affordable solution, regardless of the industry you are in.

Moving towards your current professional experiences, could you highlight some of the unique challenges and opportunities you've encountered in the industry you are currently serving?

One of the biggest challenges is the quality of data. We spend a lot of time cleaning data. You can have the mathematical model, but if you don't have accurate data, you can't make meaningful decisions out of it.

Another challenge is the generation gap. I'm from Millennia Gen X, and you are from Gen Z or Gen Alpha. That generation gap hits significantly at the workplace. Most of the time, the leadership player belongs to baby boomers or millennials. However, people who are involved in the operations belong to Gen Z or Gen Alpha. My generation looks into quality of life, and we are willing to work more than usual 9-5 jobs for the sake of earning more money. But what we have seen with the new generation coming into the play is they prefer the quality of work. They want to start work at 9 and finish exactly at 5, and they aren't willing to work more than that. They just earn for the work that they do, and they prefer to do meaningful work. So that's the main difference I have seen and one of the challenges. During teamwork, I have to be very conscious of how we (different generations) can meet expectations.

Migration is also a challenge for someone who lives in Sri Lanka. We are losing a lot of good talent in Sri Lanka. People in Sri Lanka spend 13 years at school and 4 years at university, and people learn from tax money. Unfortunately, the country hasn't received any returns due to migrating. On the other hand, there is no option for people also. They prefer the quality of life and quality of work, but the country doesn't provide that.

On a more personal note, what qualities or skills did you develop during your university years that you believe have been crucial to your professional success? Are there any life lessons or advice you wish you had known as an undergraduate?

Apart from the technical knowledge, I learned proper project management. I'm going to the most granular level during project management to ensure the output is good. That skill I learned from the university by working with multiple people.

Another quality is negotiation; when you are working as an engineer, you get many requirements from the people. Some requirements are not practical at all and are costly. So, you need to negotiate with those people and align on the same page with them.

The third one is facilitation; I had a lot of sessions at the university. Since I was the batch representative, I had to speak to a lot of people at once. At the same time, since I was a part of AIESEC, I have done a lot of training and facilitation. Because of that, within the first 6 months, I was able to register as an internal trainer at my workplace, and I still work in that position. In the corporate world, if someone is training people at the company he/she is working for, it is highly valued.

Looking back, what do you consider the most valuable aspect of your university experience in terms of personal and professional development? And if you could give one piece of advice to our current electrical engineering undergraduates, what would it be?

I think the network you build is one of the most valuable aspects. I know people from different geographical locations, and whenever I need help, I directly connect with the relevant individual. Maybe during the 4 years at the university, you don't see the value of networking because everyone is together. But once you graduate and scatter everywhere, you need that relationship. When finding the internship and current job role also, I personally knew people at those organizations, and I directly contacted them and moved there. That is critical even if you are not involved in extracurricular activities. That's what matters because technical knowledge and theoretical concepts you can learn by referring to books or the internet, but that personal relationship, you can't google and learn.

Before we conclude, is there anything else you would like to share or any additional insights you believe would benefit our current students in the electrical engineering program?

I think the first would be taking risks to get into emerging technologies. Those days when I got into this area, there was no one to help. Everyone can't take the risk of going to a totally unknown zone. At the university, you can explore the available technologies, which would be essential. Those might not be covered in your usual curriculum. Now, the internet, AI tools, and YouTube are there, so the time commitment to learn those things is mandatory.

At the same time, I want to learn how the world is moving on. Most of the time, engineering students don't read about politics, literature, and history. I think learning about those is also important and matters in your corporate life and your future as well. Humanity and understanding of music are also important as well.

On final note, if you had to summarize your university life in just three words, what would they be?

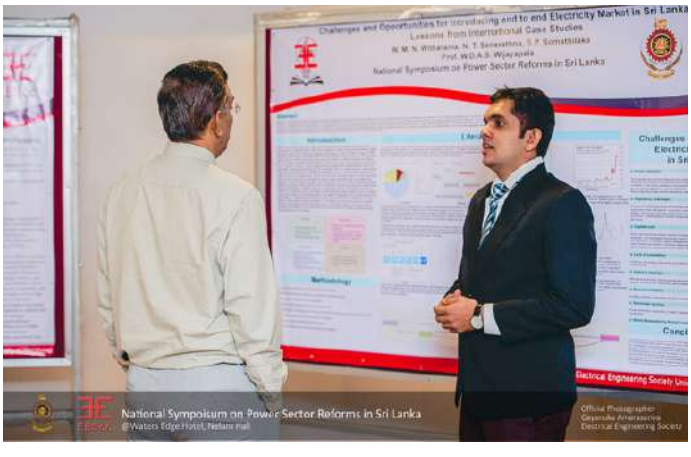
- Challenging
- Freedom
- Fun

> **"Technical knowledge and theoretical concepts you can learn by referring to books or the internet, but that personal relationship, you can't google and learn.**

THE JOURNEY OF

Mr Mudith Vitharama

Mudith Witharama, a recent graduate from the 18th batch of the Electrical Engineering Department at the University of Moratuwa, is notable for his outstanding accomplishment of winning a gold medal at the convocation. He desires to create a significant mark in the fields of science and technology by pioneering in Power Engineering and Artificial Intelligence.



Can we have a brief introduction about yourself?

I was able to choose any department for my first semester because of my high GPA. I chose to study Electrical Engineering as a result of my strong interest in the subject. I wanted something different, something that connected with my passions, rather than to go down the same path as everyone else. I prefer to find the subjects I study enjoyable when it comes to learning. This improves my understanding of them and helps me get good grades. I've also always had a strong love for teamwork. Working with people and gaining insight from their viewpoints is something I enjoy. During my time in college, I participated in a number of clubs and societies to expand my horizons and make new friends. I was able to access opportunities through organizations such as the IEEE Student Branch, Gavel, and Rotaract.

Were there any influences or passions that inspired you to choose Electrical Engineering as your Engineering Major?

Selecting a career in electrical engineering has many advantages. One benefit is its adaptability, which lets people look into a variety of career options in different sectors. The skills acquired from studying Electrical Engineering are very transferable to other fields, such as Computer Science, Electronics, and even Business. My participation in international competitions in mathematics, computer science, and physics during my school years helped me to see my potential in a variety of fields rather than focusing on just one.

I realized that concentrating on just one area might mean putting my passion for other subjects away. For the benefit of the nation, it is critical to diversify career options; a society with professionals from many fields encourages innovation and progress. My friends and I learned about a wide range of options outside of the conventional power sector after we graduated, such as those in computer science and artificial intelligence. It was definitely a smart choice to major in electrical engineering, as it opened up a variety of career options.

Could you please highlight some of your notable academic achievements before and throughout your academic journey?

Achieving the highest GPA in our department is a notable accomplishment. However, if a student pays attention in class and understands theoretical ideas well, getting a high GPA might not be that difficult. But for me, other accomplishments are more important. One such achievement was competing as a team in the International Energy and Electricity Market Business Decision Simulation Competition organized by Shanghai University of Electric Power, where we had to choose the course of action for a power and energy company's management over five years. It was a challenging but rewarding experience that called for collaboration and strategic thinking, with over 80 teams participating. I'm also proud of my involvement in the IEEE Xtreme Programming Competition. The competition has become more competitive over the last ten years, and Sri Lankan teams are finding it difficult to place in the top 50. So, it was a big accomplishment for me to be able to get a spot among those teams. I value these achievements more than just having the best GPA because they gave me recognition and more experience.

Winning the Gold Medal of the department is one of the most prestigious awards that an undergraduate can receive. How did you feel when you got to know that you would be getting the Gold Medal?

I was unaware of how I stood out from my peers until the end of semester 8 when I needed my GPA to apply for a university award. I wasn't especially pleased to find out I would be getting the Gold Medal because I wasn't actively pursuing it. But when I actually received the medal at the convocation ceremony, I couldn't help but feel happy and proud of myself.

As someone who has successfully progressed through the undergraduate experience, what advice would you offer fellow students who have embarked on their journey?

I will not limit my advice to my journey. I will give some advice from a broader perspective. Currently, students can choose from several paths. Most people prefer to go to higher studies due to the current situation in the country, while some try to enter industry, and a few try to become entrepreneurs. For those who plan to pursue higher studies, what matters most is their understanding of the subjects and their publications. I encourage everyone to make publications from the second and third years onward. By the time you go for the last semester, you will have enough publications in your CV. And if you have a specific area of interest, get a deeper understanding of that area. If you choose computer science, understand the fundamentals well. Those interested in the power sector should learn the fundamentals well so they can handle any task. If you are planning to enter the industry, develop both soft skills and technical knowledge. In the industry, you will need to work with people and manage multiple tasks, requiring additional skills beyond technical knowledge. Therefore, doing extracurricular activities, working in clubs and societies, and taking on leadership roles are beneficial. Some undergraduates are able to start startups by the time they graduate from university. This requires skills and connections. Those planning to start startups should identify talented friends, seek help from lecturers at the university, find clients, and build their companies effectively. This is also an option available to undergraduates.

What steps can one take to enhance their professional qualifications and sharpen their skills in the field of Electrical Engineering? Are there any specific tools, software, or skills that you believe are essential for future career success?

If you are going to be an electrical power engineer, your industrial training is very important. There are some companies that pay less but provide very good training experiences. When you go to interviews after graduating, training experience is what you can market in the interview. Because they want to know how you work in the industry, and their recommendations matter. So, make sure you find a good training place and work hard to gain enough experience. About the tools needed, some knowledge of AutoCAD is important, but you can easily learn it. MATLAB is sometimes needed. Other than that, some companies need PSCAD and PSSE knowledge. All companies expect you to know fundamental theoretical concepts. It is not about the grades. You should know the fundamentals.

> **“ It is not about the grades. You should know the fundamentals.**

Could you kindly share your internship experience with us and how it has aided your personal and professional growth?

I had my first training session at Amithi Power Consultants (Pvt) Ltd. They are involved in projects related to renewable energy, electrical installations, testing, electric audits, and various other areas. During my training, I had opportunities to work on multiple projects. I studied solar and biomass projects. I went on site visits with senior engineers, and I had a chance to meet foreign clients. It is like I had good exposure during the training. I did both electrical power-related work and financial work. And I had a chance to meet lots of people, and they gave me responsibilities. In the second week, they gave me a chance to visit Puttalam for a site visit for a 70 MW solar project. In the third week, I was asked to go to Mannar for a similar purpose, and I was the only representative for the company. As a trainee with only 2 weeks of experience, I was given the responsibility of accompanying the client. There was a local agent, a Chinese agent from the client's organization, and the landowner. So, as the only representative from Amithi, I went to Mannar with all of them. This experience was beneficial for my personal growth and development.

Considering your journey in the field of Electrical Engineering, what are your thoughts on the current state of the Electrical Engineering field in Sri Lanka? Are there any particular areas of growth, challenges, or opportunities that you have observed?

I see an increase in our batch's chances of finding employment opportunities. Everyone warned us when we first joined the department that there was no employment in the electrical power sector and that only around five or ten members of our batch would be recruited in that sector. In our instance, nevertheless, employment prospects originated in the electrical power sector. Opportunities have increased as a result of companies hiring our graduates and the country's energy and electrical engineering initiatives. Another alternative is to go overseas right away by submitting for permanent residency after getting some experience. It's not always the case that getting higher education is the only path to migration, unlike what some people believe. Industry engineers who have the required expertise and a strong profile have applied for PR directly with results. There are numerous opportunities, especially in the field of renewable energy. In addition, the next great revolution is artificial intelligence. I urge anyone who is interested in this field to work on projects. Even if your wages may be low at first if you decide to stay in the nation, maybe salary scales will rise over time.

> **We should be ready to learn from anyone. Every person you meet has something to teach you.**

Can we please know about your final year research project? We would also like to get advice for someone who would like to pursue a career as a researcher.

If someone is planning to pursue higher studies and become a researcher, their final year project is key. Publications are now an important factor in obtaining a Ph.D. In my case, the title of our project was "Optimal Scheduling of the Solar Microgrid Based on Solar and Load Forecasting." We made use of a dataset from the microgrid at the University of Moratuwa, which contained information on the generation of solar electricity and patterns of load consumption for a period of one month. Next, in order to reduce total costs, we created an optimisation model to determine the best battery dispatch schedule. We also developed a few demand response plans to reduce the monthly electricity bill and further optimize energy use. Also, we made a publication at an IEEE conference and are currently drafting a follow-up paper. This was a collaborative project.

Beyond your undergraduate degree, do you have plans for further academic pursuits or certifications?

Yes, I have plans. I like both industry and academia. If anyone asks about the best thing about choosing Electrical Engineering, I will say it is industrial training. I enjoyed industrial training a lot. I visited many places, met many people, and took on some responsibilities during private and CEB internships. Even after doing higher studies, we engineers can go to the industry. Some people immediately go for higher studies to leave the country at their first chance. But that is not the case for me. I'm seeking higher study opportunities aligning with my plans and goals. So, if I find a good opportunity in higher studies, I will complete my PhD, and most probably, I will follow that path.

What role do you believe mentorship and peer support play in achieving academic success?

Without peer support and mentorship, it would be much different. An example of peer support is when my friends ask questions from me, even academic questions, then I think about them, read about them, and then answer, so it helps me than them because I have a better understanding of the concepts when I clarify the concepts to someone else. There are some assignments I'm good at, and there are some assignments my friends are good at. So, when we are stuck, the help we get from each other is very important. And in the journey so far, I don't think I'm good at everything. Even in academics, my peers always had something to teach me. We should be ready to learn from anyone. I give this advice to everyone because you think you are an engineering undergraduate and you are clever, but if you live in society, every person who meets you has something to teach you. So, when talking about your batchmates, they come from different backgrounds and bring different knowledge and skills. Therefore, I encourage you to make study groups and study as a group, share your knowledge, ask questions from your friends and help others. That will help you in return.

Looking back, is there anything you wish you had known as a freshman that would have helped you in your academic journey?

I have lots of positive things to say, and I'm happy about most of my decisions. But there are things I did as backup plans. I did a lot of software work and studies as a backup plan, so if I'm unable to find a job or higher studies opportunity, then at least I can go into the software field. After graduating, I felt that although everyone says there are not enough jobs, there are opportunities for electrical engineers in all fields. If you are determined on a specific path, spending more time understanding the basic concepts will be more beneficial than having various options.

We can get an A or A+ in the last few weeks of the semester. I attended the lectures for all 14 weeks. Although I already had good grades, if I had started studying from the beginning of the semester, I would have had a better understanding of the concepts, and now I know that if I had done that, it would be beneficial for me as there are only a few people who understand the concepts.

As a fresh graduate, if you had to summarize your undergraduate years in 3 words, what would they be?

Learn – You come to university for a purpose. The most important thing is you should learn theoretical concepts and the knowledge you need to build your career. For example, learning to work in a team environment, understand others, do a good presentation, etc.

Enjoy – You are in the most beautiful age in your life. Every day you should enjoy what you do. Whether it is a lecture, assignment, or project, you find ways to enjoy it. Then, you will be able to get the maximum out of it. The other way you can enjoy it is by engaging in extracurricular activities and going on trips with your friends. When you go on a trip, you have a lot of chances to talk with your friends. So they can share their experiences with you. When doing extracurricular activities, you will face a lot of problems when organizing.

Grow – As mentioned above, you should listen to anyone. Never think like you know everything because that attitude will limit the potential hidden inside you. You should always think about how I can grow, how to improve my skills, and if it is possible to gain a certain talent and knowledge. You need to develop your personal and communication skills and the ability to manage multiple tasks. I encourage you all to do a self-analysis and find ways to improve yourself.

IPD COLOMBO

IPD Colombo is a leading company in the field of electrical engineering, founded in 2005 as a part of IPD, an Australian company. It specializes in various areas such as power distribution, monitoring, industrial control, photovoltaic, automation, communication, and HVAC.

Starting with just two people in Australia, IPD Colombo has grown significantly. It now has over two hundred professionals in Sri Lanka and 290 experts across different units in Australia. This growth reflects IPD Colombo's commitment to excellence and customer satisfaction. The company is known for its agility, efficiency, and proactive decision-making. It has a skilled and experienced team that caters to customers' needs, ensuring a smooth experience.

IPD Colombo's goal is to improve infrastructure by focusing on energy efficiency, automation, and secure connectivity while prioritizing the safety and well-being of people. This goal is supported by a team of dedicated individuals who bring expertise and commitment to every project, ensuring that customers receive excellent service. The company's values include being down-to-earth, innovative, and hardworking. These values are reflected in its culture, which provides an environment where individuals can succeed and develop in their careers

IPD specializes in providing high-quality power distribution solutions, including DIN MCB and load centers, molded circuit breakers, air circuit breakers, transfer switches, surge protection, and electric vehicle charging infrastructure. They also offer custom solutions for distribution boards and switchboard systems. For power monitoring, they offer a variety of products, from kilowatt-hour meters to multifunction meters and advanced electrical network analyzers. These products help businesses track and optimize power consumption effectively. In renewable energy projects, IPD provides custom solutions like DC miniature circuit breakers, isolators, surge protection, and monitoring systems. These ensure seamless integration and maximum efficiency in solar installations.

For industrial control, their range includes contactors, motor breakers, smart controllers, and automation systems, which improve productivity and efficiency in operations. IPD also offers industrial automation and communication solutions for data centers and industrial facilities. These include automation systems, motor controls, and network solutions. In HVAC systems, they specialize in providing innovative solutions for heating, ventilation, and air conditioning, ensuring they perform efficiently and effectively.

IPD Colombo's dedication to supporting and encouraging the next generation of electrical engineers is demonstrated through its partnership with EESpire'24, the career fair organized by EESoc of the electrical engineering department. As the platinum sponsor of this prestigious event, IPD Colombo played a crucial role in empowering and motivating aspiring engineers. We extend our heartfelt gratitude to IPD Colombo for standing together with EESoc to empower and inspire the future generation of electrical engineers.

IPD Colombo's path shows its strong dedication to excellence, innovation, and supporting talent in electrical engineering. As they keep making advancements in the industry, their influence goes beyond borders, shaping the future of electrical engineering for generations to come.

SOUTH ASIA GATEWAY TERMINALS

Established in 1999, South Asia Gateway Terminals (SAGT) stands as the pioneering private container terminal operator in Sri Lanka, marking a transformative moment for the Port of Colombo. Its inception propelled the port into a global trade gateway for South Asia, and over the years, SAGT has played a pivotal role in solidifying its position among the three key operators in the port today.

SAGT is not merely a container terminal operator; it is an innovative and technology-oriented company dedicated to staying at the forefront of industry advancements. The firm actively embraces sustainability practices, recognizing the profound impact its operations can have on the country's economy. The company proudly engages as a Gold Partner in EESpire 2024, showcasing its commitment to nurturing talent and fostering innovation in the maritime sector. With nearly 60% Sri Lankan shareholding, SAGT operates as a Board of Investment (BoI) flagship entity, backed by influential stakeholders like John Keells Holdings, APM Terminals, Sri Lanka Ports Authority (SLPA), and Peony Investments (a subsidiary of Evergreen Marine Corporation).

Throughout its more than two-decade history, SAGT has consistently earned globally recognized "best practice" awards, a testament to its unwavering commitment to maintaining the highest operational standards. As a global container terminal, SAGT's transformative role in the Port of Colombo positions itself as a leading force in the international maritime industry. The company not only embodies a commitment to excellence and innovation but also actively nurtures talents in fields such as Health and Safety, Commercial and Marketing, Finance, Engineering, and IT & Operations.

With a team dedicated to driving positive change, SAGT is constantly on the lookout for individuals who posses the right attitude and optimism. The company offers rewarding opportunities in logistics, supply chain management, and various disciplines within the maritime sector. SAGT invites those who share their vision for progress and innovation to join their mission, contributing to the continual advancement of global trade.

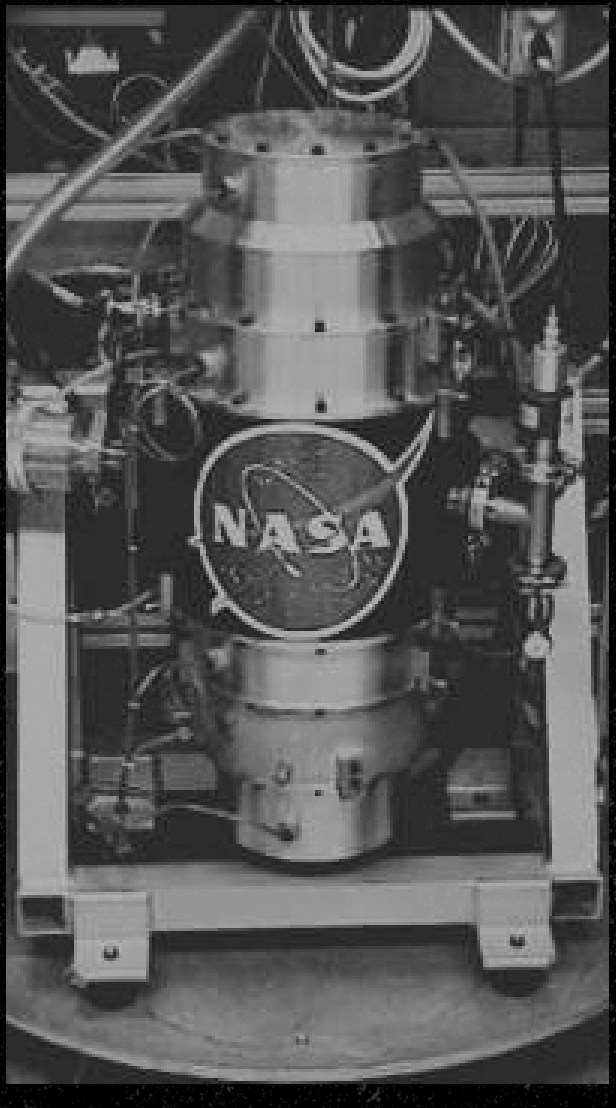
TRADE PROMOTERS LIMITED

Trade Promoters Limited (TPL) was founded in 1976 and is the authorized distributor of Schindler products, such as escalators, elevators, moving walkways, diesel generators and engines for marine and industrial applications in both Sri Lanka and Maldives. It is the industry leader in Sri Lanka's diesel generator and elevator markets, strengthened by its staff of knowledgeable engineers and factory-trained technicians. They are also pioneers in generator controllers, marine generator controllers, engine controllers, ATS controllers, control panels and battery chargers for SmartGen. TPL has collaborated on its more than three decades-long partnership with Schindler and Cummins Inc.

TPL has the honour of certifications including ISO 9001:2015 Quality Management Systems, Construction Industry Development Authority (CIDA) certification and also Gold level certification of Cummins Excel Audit. The company's main goals are to enhance people's quality of life by using creative power and mobility solutions, establish a vibrant workplace to motivate their staff to surpass their partners' expectations and acknowledge that it is their duty to create a safer and more environmentally friendly world.

It is proud of its skilled personnel, who combines professional and technical abilities to meet the demands of its clients. The company assists clients from the initial load survey through installation, servicing, and maintenance. Through the provision of Automatic Transfer Switches, sound attenuation, and other control equipment, the organization adds value locally.
TPL proudly engages as a gold partner in EESpire 2024, showcasing its commitment towards the automation industry and power generation. TPL is dedicated to continuously pursuing system performance enhancements, with a particular emphasis on reducing the possibility of downtime for its clients.

SPARK
INSIGHTS



ARTICLES

HYDROGEN STORAGE SYSTEM UTILIZATION IN MODERN MICROGRIDS

Raveen De Silva
Instructor

Revolutionizing Microgrids and Fueling the Future of Global Energy

Hydrogen storage systems are increasingly being considered as a promising energy storage option in modern microgrids. Hydrogen-based energy storage systems are best suited for microgrids and can successfully be used to serve remote communities where the distance from the nearest grid is significant. The integration of hydrogen technologies in microgrids generally involves a "power-to-power" process, where hydrogen is produced and stored during periods of energetic overproduction due to the excess renewable energy available [1-4]. During periods of energy shortages, hydrogen is used to generate electricity. Hydrogen energy storage systems are economically feasible in current fuel cells and electrolyzers, and the actual storage of hydrogen is cheap, with a trade-off of relatively higher capex due to charging and discharging. The major cost in a microgrid is the energy storage system, and if sized smartly, the cheap hydrogen storage medium that doesn't lose energy is durable, and isn't affected by charging cycles offsets electrolyzer and fuel cell costs [5].

Environmental friendliness and hydrogen color coding.

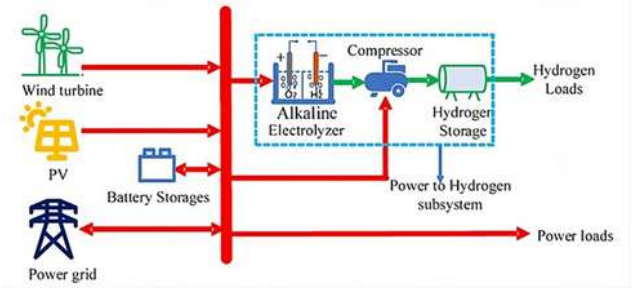
Researchers provide a comprehensive understanding of the different color-coded hydrogen types, their production processes, and their environmental friendliness. Despite the current cost considerations, they also outline the potential of green hydrogen as a future energy source. There are several types of hydrogen, including brown, gray, blue, turquoise, and green hydrogen. Green hydrogen, produced using renewable energy for water electrolysis, is considered the most environmentally friendly [5, 6]. Hydrogen can be extracted through various methods, such as thermochemical, electrolysis, direct solar and water splitting, and biological processes. Thermochemical processes involve using thermal energy to release hydrogen from the molecular structure of various sources such as natural gas, coal, and biomass. Electrolysis processes involve the use of an anode and a cathode separated by an electrolyte material. Direct solar and water-splitting processes use concentrated solar heat to produce hydrogen and oxygen from water. Biological processes involve using microorganisms such as bacteria and microalgae to produce hydrogen through fermentation-based systems.

Despite the current cost considerations, the potential of green hydrogen as a future energy source has been analyzed in various industrial applications [6-8]. They outline that with the advancement of technology and mass production, economists have estimated that the cost of green hydrogen will decline soon.

Hydrogen Energy Storage in Modern Microgrids: Opportunities and Challenges

Energy storage is vital for the stability of microgrids, as it enables them to balance electricity supply and demand. While batteries are the most common energy storage system in microgrids, they are not suitable for long-term energy storage on their own. To address this limitation, battery energy storage systems (ESS) can be combined with hydrogen storage

in renewable microgrids, allowing the microgrid to transition to a completely clean and renewable system by storing renewable hydrogen throughout the year [6, 7]. This setup in Figure 1 [4] accommodates the cyclical patterns in power demand and the fluctuations in renewable energy sources such as solar and wind. Green hydrogen, captured and stored during periods of excess renewable energy, can be used to meet electricity demand during times of low renewable energy generation, such as winter months with less sunlight. This integration of green hydrogen into microgrids enhances energy independence, resilience, and the utilization of renewable energy, reducing the dependence on traditional fossil fuel-based energy sources.



The schematic of wind-PV-hydrogen-storage microgrid. (Source - https://www.mdpi.com/1996-1073/15/8/2861) [4]

Green hydrogen can be utilized within microgrids in various ways, including electricity generation, energy storage, fueling backup systems, transportation, and sector integration. For instance, green hydrogen can be converted back to electricity through fuel cells, providing clean and reliable power during peak demand or when renewable energy generation is limited. It can also be stored as a form of energy storage within the microgrid and used to fuel backup systems, such as hydrogen fuel cells or generators, ensuring uninterrupted power supply during grid outages or emergencies. Moreover, green hydrogen can be used as a clean fuel for transportation purposes and can enable sector integration by providing energy for heating, cooling, industrial processes, and the production of synthetic fuels.

The role of microgrids in green hydrogen production is significant, as microgrids when paired with energy storage, can maximize the amount of green hydrogen production. The intelligent controls and energy storage systems of microgrids can manage the intermittent nature of renewables, turning variable renewables into firm power to feed the electrolyzer, thus enhancing the economic efficiency of power-to-gas systems [8].

The integration of green hydrogen into microgrids contributes to greater energy independence, increased resilience, and a higher share of renewable energy utilization. It serves as both a source of clean power and an energy storage medium, allowing microgrids to balance electricity supply and demand while reducing reliance on traditional fossil fuel-based energy sources.

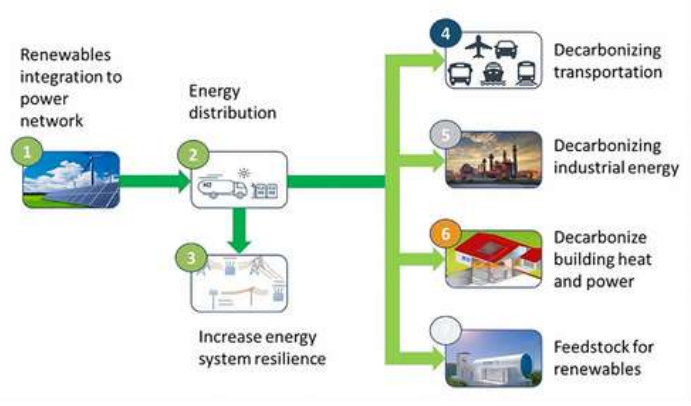
The concept of a hydrogen economy envisions hydrogen as the dominant energy carrier, facilitating the large-scale integration of renewable energy sources [9]. This vision offers several potential benefits, including decarbonising hard-to-abate sectors such as steel, maritime, aviation, and ammonia production and providing clean feedstock for industry. Hydrogen's versatility allows it to address the intermittent challenges associated with renewables and act as a buffer to enhance the resilience of energy systems. However, the full realization of the hydrogen economy requires substantial steps across the supply value chain, including deploying hydrogen infrastructure and scaling up manufacturing capacities to achieve competitive costs and mass market acceptance. International cooperation and partnerships are deemed crucial in assisting developing countries in transitioning towards a sustainable hydrogen-powered future.

The future of hydrogen looks promising, with the cost of green hydrogen expected to decrease over time due to falling renewable energy production costs, economies of scale, and technological advances. This trend is anticipated to make green hydrogen more economical, leading to its increased demand across various sectors, including industrial, transport, energy, and buildings. The reports [7-10] also emphasize the need to scale up technologies and bring down costs to enable the widespread use of hydrogen and to tackle various critical energy challenges.

Several case studies [10] demonstrate the successful integration of hydrogen storage systems in microgrids. However, limited industry and practical experience are barriers to the implementation of hydrogen storage systems. Large-scale deployment of hydrogen transport solutions would require major investments in hydrogen infrastructure. An important barrier to this infrastructure development is the synchronization of FCEV ramp-up and infrastructure development. Investments in refueling stations pay off only if vehicle numbers grow, but developing, building, and marketing vehicles is viable only with an adequate refueling infrastructure. The number of hydrogen refilling stations under development worldwide is increasing, and cost reduction is driven by three factors related to the manufacturing scale-up: technological and operational improvements, increasing station sizes, standardization, and rationalized regulatory requirements.

As depicted in Figure 2, hydrogen can play a pivotal role in seven major transformations worldwide. It can enable large-scale renewable energy integration, distribute energy across sectors and regions, act as a buffer to enhance energy system resilience, decarbonize transportation and industrial energy use, contribute to the decarbonization of building heat and power, and provide a clean feedstock for industry. The potential impact of the hydrogen economy extends beyond environmental benefits, offering opportunities to create green jobs, acquire new skills, promote green industrialization, and increase access to clean and affordable energy. While challenges such as cost-effectiveness and infrastructure development persist [10], a collaborative international approach can pave the way for a more environmentally conscious and sustainable future for all. The hydrogen economy concept presents a transformative vision for a sustainable and clean future, particularly beneficial for developing nations.

At its core, this idea revolves around hydrogen becoming the dominant energy carrier, ushering in large-scale integration of renewable energy sources. Hydrogen's versatility allows it to act as a buffer, increasing the resilience of energy systems and addressing the intermittency challenges associated with renewables like solar and wind.



Hydrogen: Seven major roles
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ELECTRICAL VEHICLES FOR A GREENER FUTURE

Lishani Walpita
21 Batch

> **Can electric vehicles transform transportation for a greener future?**

Electric vehicles (EVs) revolutionise transportation with clean, efficient power, reducing emissions and advancing sustainable mobility for a greener future. Vehicle fundamentals can be divided into two main categories:

1) The Motor

First, let's talk about the motor. Potential energy is transformed into kinetic energy by the motor. You may believe that there are many different kinds of motors, and reading through all the pages about various petrol engine types may lead you to believe that, but there are really just two main kinds of motors. This has always been the case throughout human history. The heat engine is the first type of motor, and the electric engine is the second.

In a heat engine, the potential chemical energy in a fuel is released through combustion. Heat causes expansion, resulting in a rotating motion. It operates through intake, compression, ignition, and exhaust strokes. Fuel is introduced, compressed, and ignited, and the resulting explosion propels the cylinder, resembling a bicycle pedal's motion. The complexity of the engine, involving numerous precision parts, contributes to its weight and cost. High heat and explosions lead to substantial wear and maintenance requirements, resulting in rapid deterioration. Despite the potential for improved efficiency, achieving 50% efficiency would increase costs and require a challenging, constant rate of explosions per minute in real-world conditions.

Despite over 150 years of improvement, internal combustion engines, especially in regular cars, still waste over 75% of their energy as heat. High-performance cars like the Bugatti Veyron can surpass 95% waste in city traffic. The major concerns for health and climate change lie in exhaust fumes, as burning 1 L of gasoline produces 2.3 kg of carbon dioxide gas, posing significant environmental challenges.

Electric engines, relying on magnetic fields, demonstrate superior efficiency, durability, and eco-friendliness. With a single moving part, the rotor, electric motors offer light, compact, and cost-effective solutions. High energy efficiency, renewable energy compatibility, and zero emissions make electric vehicles, on average, four times more efficient than conventional cars. Despite these advantages, the primary challenge lies in energy storage, where batteries still lag behind traditional fuel, leading to the prevalence of gasoline engines.

Heat engine vs electric motor

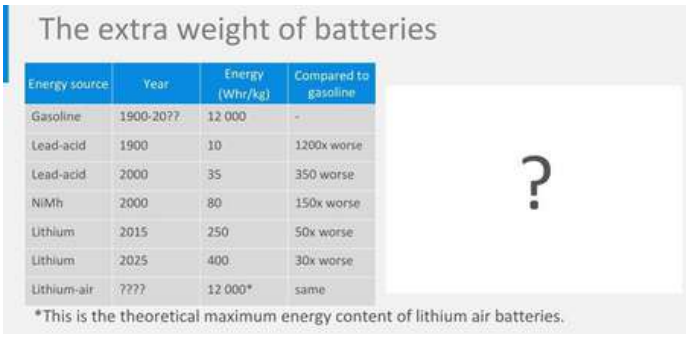
Internal combustion	Electric motor	Electric motor is...
1-3 kW/kg	3-10 kW/kg	3x more powerful
0.4 kW/L	13.6 kW/L	40x smaller
5-30 % efficient	93-96 % efficient	3-20x more efficient
Many moving parts	One moving part	Maintenance free

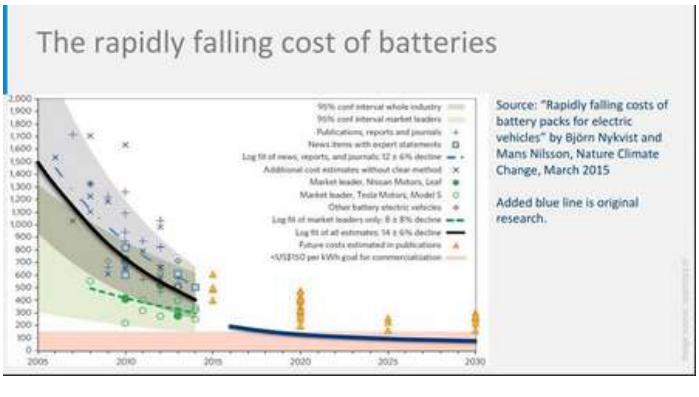
2) Energy Storage System

While electric engines succeed in motors, heat engines, like petrol engines, outperform in energy storage. Battery technology has advanced throughout time, but its energy density has traditionally lagged significantly behind that of fuel.

Recent technological breakthroughs, particularly with lithium batteries, have greatly reduced weight, making electric vehicles more viable. As battery technology advances, the weight differential narrows, and by 2025, electric vehicles are predicted to outperform conventional vehicles in terms of overall weight efficiency. Lighter vehicles improve agility and reduce raw material costs, potentially making electric vehicles more cost-effective while maintaining efficiency and lowering environmental impact.

Are plug-in hybrid electric vehicles more than merely a short-term transition to fully electric vehicles? Why would you put up with the costs and complications of a fuel-cell electric vehicle? Let's discuss the pluses and negatives of various electric vehicle models. In particular, hybrid electric vehicles, fuel cell electric vehicles, plug-in hybrid electric vehicles, and fully electric automobiles.





i. Hybrid Electric Vehicles

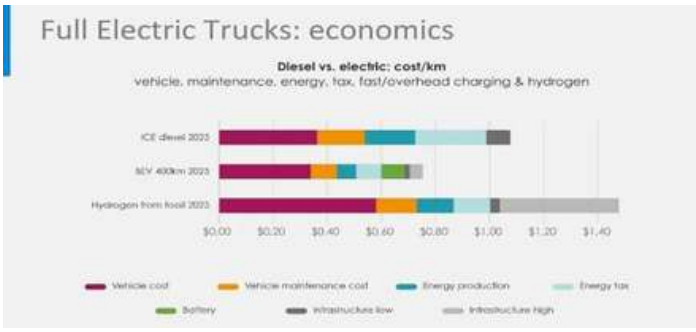
The world discovered the electric engine due to all the issues with combustion engines and biofuels. The hybrid electric car was the first action. The hybrid electric vehicle (HEV) combines a traditional engine with an electric motor and battery, prioritising electric power during inefficient moments like stop-and-go traffic.

The gasoline engine recharges the battery at other times, reducing wear on the engine and brakes. While HEVs offer financial benefits over their lifetime due to fuel savings, the overall efficiency gain is limited, typically around 10-20%. In contrast, plug-in hybrid electric vehicles (PHEVs) have both conventional and electric drivetrains, offering a longer range with a smaller battery. PHEVs can quickly replenish energy at gas stations but have disadvantages, including a more expensive and complex drivetrain, higher maintenance costs, and less CO2 reduction compared to fully electric cars.

ii. Fully Electric Vehicles

A full electric vehicle (FEV) only uses an electric motor fuelled by a sizable battery, doing away with the traditional drivetrain. One-pedal driving, in which the throttle pedal controls both acceleration and deceleration and energy-capturing regenerative braking, is a noteworthy feature. The main disadvantage is that an adequate range requires a large battery; most experienced FEV drivers are content with a range of 400 to 500 kilometers. Notwithstanding this drawback, electric vehicles (FEVs), particularly those similar to Tesla models, are predicted to rule the market going forward. For extended travel, fast charging (up to 50 kW) is essential, giving about 250 km of range in an hour. However, improvements are anticipated, with new cars estimated to reach an average of 250 km in roughly 15 minutes within the next five years. More and more people are choosing fully electric vehicles (FEVs) for economic reasons as opposed to environmental ones. FEVs become more economical choices because they require only one-third of the energy and have fewer maintenance requirements. Falling battery costs make FEVs more affordable up front, allowing manufacturers like Tesla to sell high-performance electric cars at competitive rates. Factors such as the declining cost of electric drivetrains and the anticipated tenfold decrease in battery prices by 2030 make plug-in vehicles (FEVs) a strong competitor for internal combustion engines.

The financial benefits of FEVs, such as substantial fuel savings of between $10,000 and $30,000 over the course of the vehicle's lifetime and lower maintenance costs, demonstrate how, from being a disadvantage in 2000, they will become a significant advantage by 2030, particularly for those looking for larger, more exciting, and sportier cars.



iii. Hydrogen Fuel Cell Vehicles

A hydrogen fuel cell vehicle functions essentially as a battery electric vehicle with a range extender, offering advantages like a smaller battery, long-range capabilities, and rapid refueling. However, the current challenge lies in hydrogen production, with 90% derived from non-emission-reducing methods. Even with green production, hydrogen's efficiency is lower than that of direct electricity use. The conversion process results in about one-third of the energy being utilized, improving to about half in the distant future. Hydrogen becomes more practical for energy storage when solar and wind generation exceeds 80%, especially in regions without a grid connection. For locations like Siberia or Australia, lacking grid connections, hydrogen proves cost-effective for capturing and transporting solar and wind energy. While hydrogen fuel cell vehicles have advantages, their efficiency and emissions reduction depend on production methods and the specific energy landscape of a region. Although there are cost-effectiveness issues preventing hydrogen from being used in cars, hydrogen is predicted to play a part in the future renewable economy. Hydrogen's future depends on how much fuel cells, storage, and electrolysis cost. Compared to fully electric vehicles, hybrid drivetrains are more complicated, and a transition from hybridization to fully electric vehicles is anticipated as battery prices drop. You can avoid plug-in hybrids, especially if you drive a heavy truck.

The fundamentals of economics show a very evident trend: the internal combustion engine is becoming less common, indicating a shift towards more electric vehicles in a number of industries. In the future, drivetrain and energy storage technologies will have a big impact on how transportation is made.

EMBRACING EFFICIENCY WITH INTELLIGENT AUTOMATION

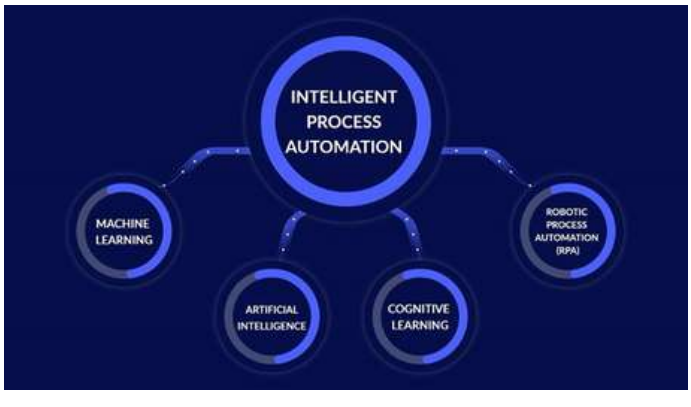
Menusha Fernando
21 Batch

> **Ever considered using intelligent automation to boost efficiency?**

Artificial intelligence (AI) and automation technology improve corporate operations. This is achieved by integrating robotic process automation, natural language processing and machine learning to create systems capable of learning, adapting and performing tasks without constant human input. Improved productivity levels, fewer errors, and changed workflows enable organisations to use this interaction to make data-driven decisions, reduce redundancy, streamline workflow, and remain agile even as they change in a fast-changing digital environment.

What is Intelligent Automation?
Robotic process automation (RPA) and artificial intelligence (AI) technologies are used to create intelligent automation (IA), which speeds up digital transformation and allows for quick end-to-end business process automation. IA seeks to greatly broaden the scope of business process automation by fusing RPA's task execution with machine learning, autonomous process discovery, process analytics, and cognitive technologies like computer vision, Natural Language Processing, and fuzzy logic.

But how does this Intelligent Automation work?
It harnesses and integrates cognitive technologies with RPA. In brief, it starts with process discovery and optimises the systems with feedback from customers. With the integration of AI and RPA, even the most intricate commercial tasks can now be automated. The possibilities for business process automation are now nearly limitless as AI expands the capabilities of RPA. For instance, cognitive bots possess the ability to reason and make informed decisions. They can even develop their skills while on the job, becoming essential members of your team of human and digital workers. This advanced form of automation has the potential to completely revolutionize the way businesses operate, seamlessly weaving together people, technology, and work processes.



Through the incorporation of advanced cognitive technologies, Automation Anywhere has created an intuitive and accessible AI platform that outshines all other intelligent automation platforms. This innovative system allows for a comprehensive overview and analysis of all data and outcomes through a single, all-encompassing dashboard.

The benefits of Intelligent Automation

- Automate any business process end-to end.
- Reduce operational obstacles.
- Organize and process complex data.

Where can Intelligent Automation make an impact?

- Healthcare
- Technology
- Public sector
- Banking
- Life sciences

Recent advancements in machine learning (ML) have exponentially increased computational capacity, revolutionizing the field of artificial intelligence (AI). Now, even complex models can quickly analyze large datasets, thanks to the rapid progress in ML techniques. Additionally, the emergence of context-aware computing and real-time data acquisition from online sources has greatly expanded the pool of data available for AI training. Furthermore, the compatibility of powerful graphics processing units with complex deep learning and reinforcement learning algorithms has further enhanced the capabilities of AI.

Streamlining process tasks through automation tools can save time and effort by automating repetitive, rule-based tasks. This not only reduces errors but also increases accuracy and speeds up processes. With the help of machine learning algorithms, systems can learn from data patterns and past interactions. This flexibility allows for optimized decision-making processes and adapting to changing situations. Intelligent automation tools are highly efficient when large amounts of data are processed.

They can extract insights, identify patterns, and conduct intricate analyses, ultimately providing valuable information for informed decision-making.

There is no denying the immense impact that the integration of artificial intelligence (AI) and automation technologies has had on corporate operations. Intelligent automation systems have truly revolutionised the business world by combining robotic process automation (RPA), natural language processing, and machine learning. With its many benefits, including increased productivity, minimized errors, smoother workflows, and data-driven decision-making capabilities, this advancement has undoubtedly elevated corporate functioning.

By leveraging the power of cognitive technologies and RPA, intelligent automation effectively automates complex business tasks, expanding the potential for more streamlined business process automation.

The incorporation of AI and automation on a wide scale has the power to transform the way businesses run, fostering a harmonious blend between human and digital employees in the constantly evolving digital landscape.

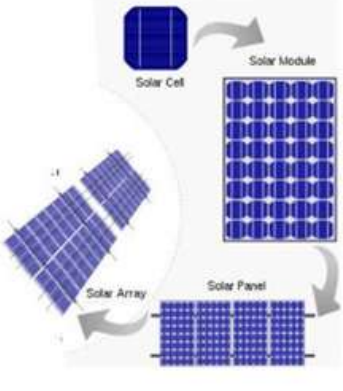
EMERGING SOLAR POWER GENERATION

Poojani Yataththawala
19 Batch

> **Solar PV systems harness energy of the sun, laying the foundation for sustainable power generation**

Researchers have paid deep attention to renewable energy to overcome prejudicial circumstances, mainly environmental disorder due to carbon emissions, using conventional energy sources like thermal energy. So, among all these renewable energy sources, generating energy by solar photovoltaic (PV) power is blessed under renewable energy resources such as wind, rain, tides, waves, geothermal heat, and biomass due to qualities such as zero pollution, zero noise, safety, reliability, convenience, and low maintenance. Also, it is a trending field currently.

So, What is solar PV?

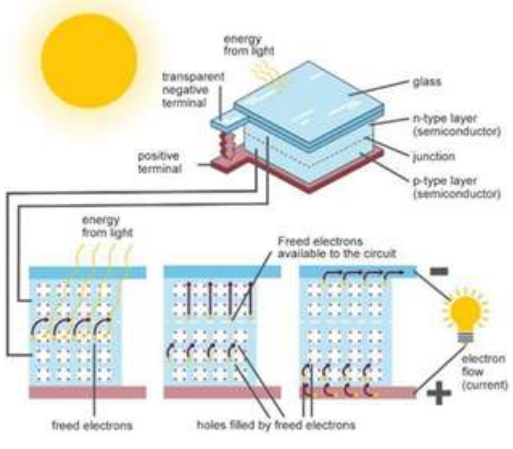


Solar cell to PV system

Here, you can observe that solar cells are connected, creating solar modules. These solar modules, in turn, consist of solar cells, and solar modules lead to solar panels, ultimately forming an array. The primary function of these solar panels is to convert solar energy into electric current through a process known as the photovoltaic effect.

During this process, solar radiation strikes the photovoltaic (PV) device when panels are exposed to sunlight. The energy from the sunlight is then transferred to the electrons in the semiconductor material, usually made of silicon. As a result, these energized electrons start to flow, generating an electric current. This electric current produced by the solar cells is in the form of direct current (DC), and it is later converted to Alternating Current (AC) by power electronics converters.

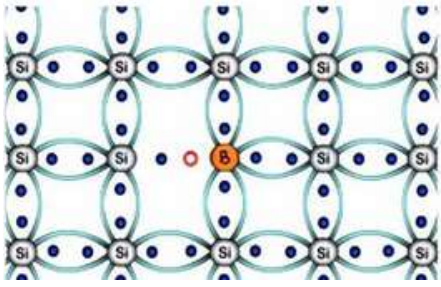
First, we move into the solar cell; what is this little gadget?



Inside of a Solar Cell

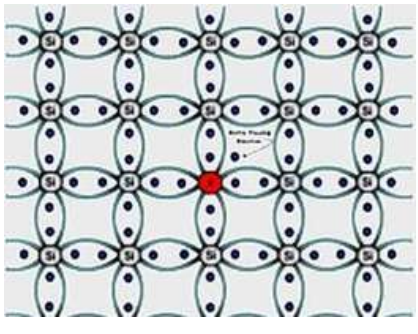
The above picture tells us what happens inside the cell when solar radiation hits the solar cell. PV cells have non-linear characteristics. Solar cells are made from semiconductor materials and use silicon (Si). The inside of the cell is a P-N junction made using a P-type semiconductor and an N-type semiconductor. Here, P stands for positive, and N stands for negative.

P-type semiconductors are made by doping Si / Ge with an element of the 13th category in the periodic table. For example, Boron and N-type semiconductors are produced by doping Si/Ge with an aspect of the 15th category.



(Boron doped Si structure)

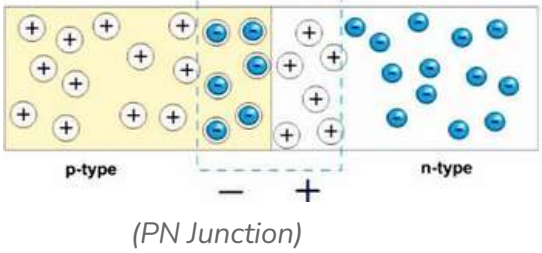
According to the picture, when Si is doped with Boron, since Boron has only 3 electrons in its outer shell (while Si has 4), there is a need for one electron to form the bond between Si and Boron. The absence of an electron is analogous to having an extra proton. Therefore, this is termed a P-type semiconductor, and the flow of electrons occurs by replacing holes with electrons. Note that the material remains electrically neutral.



(Phosphorous doped Si structure)

According to the picture, when Si is doped with Phosphorus (P), since Phosphorus has 5 electrons in its outer shell, but Si has only 4 in its outer shell, there is a need for one hole to form the bond between Si and Phosphorus. The number of combined bonds between two atoms typically does not exceed 4. A missing hole is akin to having an extra electron. Therefore, this is termed an N-type semiconductor. Note that the material remains electrically neutral.

Now, with a solid understanding of P-type and N-type semiconductors, the P-N junction is formed by connecting these two semiconductor types, as shown below.



(PN Junction)

An electric field is created in the direction of the arrow in the picture, and by supplying voltage from a voltage source, we can generate a good current. Even without supplying a voltage, a small current flows across it due to the existing electric field. The DC output is subject to variations based on factors such as solar radiation and temperature.

Now, let us move on to what factors affect solar PV system efficiency. Power generation from solar systems can be influenced by various factors, leading to potential instability due to severe weather, sunset, and natural limitations. Several key elements directly impact the efficiency of PV system power generation.

1. Solar radiation intensity – With the high intensity of solar radiation, the power generation should also be higher than before.
2. PV material – Efficiency varies from material to material.
3. Weather conditions – Sunny weather is mainly affected.
4. Inverter efficiency – DC to AC converters typically have 96%-97% efficiency. When DC input is getting high, inverters have higher efficiency.
5. Temperature – According to bostonsolar.us, the temperature coefficient tells how much power is lost when the temperature of the PV system increases over 25°C, according to increments of 1 degree Celsius. For instance, the temperature coefficient of the LG Neon 2 solar panel is -0.38% per one degree Celsius. This means that at one degree Celsius above 25°C, the maximum efficiency of an LG Neon 2 solar panel will decrease by 0.38%. Conversely, for one degree Celsius below 25°C, the maximum efficiency of that solar panel will increase by 0.38%.
6. Geographical location – This is also directly affected, in fact, by the tilt of the panels that are made with the direction of sunstrokes. The radiation density on a unit area varies according to that angle.
7. Dust on panels – Clouds of dust are due to trees, wind, and so on covering the surface of the panel from sunlight. It causes a decrease in efficiency.
8. Shading – Shadows covering panels can interrupt power generation efficiency.
9. Mismatch – A mismatch between modules can lead to a decrement in performance.
10. Age – As solar systems age, they tend to produce less energy, with a typically assumed decrease in performance of around 0.5% per year.

EMPOWERING SRI LANKA'S MOBILITY: INTEGRATING ELECTRICAL ENGINEERING FOR SUSTAINABLE TRANSPORTATION

Gayuru Ramanayake
21 Batch

> **Future of transportation with electric vehicles and smart charging solutions**

Sri Lanka is a nation that is currently dealing with critical challenges in its transportation sector, such as fuel shortages and unexpected fuel price rises. It is a country that still lacks a reliable and effective public transportation system. This article investigates electrical engineering's revolutionary role in restructuring the nation's mobility. The world is rapidly shifting towards electric vehicles. It is because not only are they cost-effective, but they also have a positive influence on the environment. Therefore, bringing electric vehicles into play, along with a strong charging infrastructure, becomes an important factor in making sustainable development in Sri Lanka. The primary concept here is to employ strategic applications of electrical engineering to revolutionize the nation's transportation while providing affordable and eco-friendly solutions.

Currently, the global electric vehicle market is experiencing explosive growth by offering valuable insights into Sri Lanka's electrical vehicle adoption strategy. According to some resources, there are 26 million electric cars on the road in 2022 which is 5 times more than the increase from 2018. Furthermore, Europe plans to sell only electric cars and hydrogen cars starting in 2025. Moreover, Countries such as Japan, Norway, Sweden, and Switzerland have achieved high levels of penetration of electric vehicles through targeted policies centered on tax breaks, infrastructure development, and public awareness campaigns. This dominance demonstrates the huge potential for rapid adoption of electric vehicles in developing countries with supportive policies and infrastructure. The Sri Lankan government can introduce strategies to maximize the adoption of electric vehicles by analyzing these global trends. These applications can ensure that the transportation sector of Sri Lanka effectively leads toward a sustainable future.

Electric vehicles do not emit tailpipe emissions; therefore, they do not contribute to air or greenhouse gas pollution. Consequently, electric vehicles contribute significantly to reducing carbon emissions. Energy generation from fossil fuels is less polluted than a typical gas-powered vehicle. Therefore, electric vehicles contribute significantly to reducing carbon emissions. Energy generation from fossil fuels is less polluted than a typical gas-powered vehicle. This helps to mitigate the environmental impact associated with traditional combustion engines. Countries like Norway, with a high rate of electric vehicle adoption, have seen tangible reductions in air pollution, showcasing the positive environmental impact. In addition, electric

vehicles operate significantly more quietly and smoothly than typical combustion engines. The reason for this is that electric motors generate less vibration and noise. From this, the passengers could experience a more peaceful and pleasurable driving experience. Improvements in battery efficiency and recyclability are two crucial technological advancements in the electric vehicle sector that can enhance their overall sustainability. Affordability is another significant factor to consider when attaining sustainable transportation. Although the operating cost of electric vehicles is law, the biggest regression of electric vehicle owners is the high battery cost that costs a fortune for them. Having subsidiary programs such as China to reduce the upfront cost allows electric vehicles to be more affordable for a wider population. Finally, Sri Lanka could leverage these global examples and technological advancements to tailor its environmental strategies and adopt cutting-edge technologies for sustainable transportation.

Electrical engineers play a crucial role in leading Sri Lanka toward sustainable transportation. They design cutting-edge solutions to address the unique challenges and opportunities present in the nation's mobility landscape. In the electric vehicle industry, they are responsible for designing and implementing electric vehicles, developing the circuit that charges the battery, and distributing the current to the electric motor in electric vehicles. In addition, they also contribute to the development of the charging infrastructure and address challenges in charging station placement and energy distribution. Countries such as Norway and China are global pioneers in electric vehicle adoption.

Electrical engineers have been at the forefront of developing charging networks that have contributed to those country's successful transition toward electric vehicles. Electricity engineers are making efforts to design smart charging networks for electric vehicles that are powered by renewable sources. This will help in promoting the adoption of electric vehicles on a large scale. Electrical engineers can also use these principles to electrify public transportation systems using clean power. Such applications can lead Sri Lanka's transportation system toward a more sustainable future.

Advancements in electrical engineering have the potential to address critical issues such as traffic congestion, pollution, and increasing energy consumption. Our country can revolutionize its transportation system by following global best practices, promoting local innovation, and implementing strategic planning. Consequently, Sri Lanka can lay a solid foundation for a more sustainable and eco-friendly future.

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EXPLORING THE ROLE OF ENF ANALYSIS IN ENHANCING AUDIO FORENSICS

Danika Rodrigo
21 Batch

“Can a power line act as a police informer?

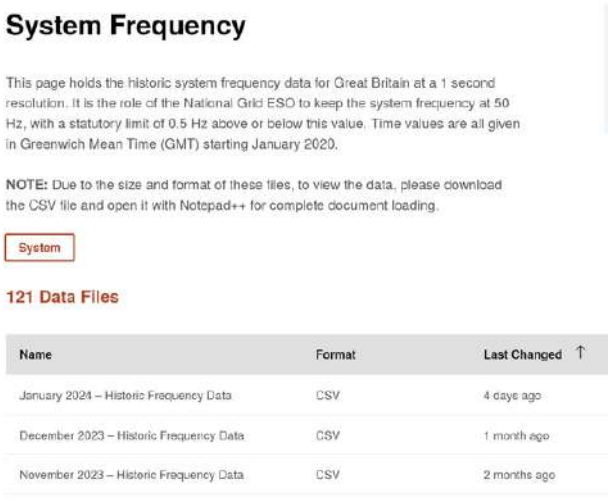
Have you ever wondered about the phrase ‘power lines acting as police informers’? It’s a fascinating concept that has recently been brought to light by advancements in the field of digital signal processing. It is exactly what these power lines are doing while they produce this hum due to the ever-so-slightly changing frequency of the current. It acts as a watermark in the digital recordings, which can be used to uncover hidden yet crucial details about the time of recording or possibly even discover the geographical location at which it was recorded.

The power lines in the city area in Dubai create a stunning view during sunset.

Traditional audio forensic methods include spectrographic analysis, voice identification, and noise reduction techniques. Unlike traditional methods, ENF analysis does not rely on the audio content itself but rather on the inherent frequency variations present due to electrical grid fluctuations. This means that ENF analysis can authenticate recordings even in cases where the audio content has been heavily altered or manipulated.

Transmission lines in most parts of the world distribute electricity at frequencies of 50 or 60Hz, based on the geographic region. Due to certain inherent imperfections present in the transmission lines, a portion of the distributed power will be converted to mechanical vibrations. This phenomenon is often responsible for the audible hum that can be heard near power lines. While this hum may not be readily noticeable near distribution lines, which deliver power to our homes, it becomes more pronounced in the vicinity of high-voltage transmission lines. The grid frequency rarely remains constant at its rated level; it gradually shifts due to fluctuations in electricity supply and demand. By plotting the variation of grid frequency over time and comparing it with the mains hum extracted from an audio recording, we can align the hum's frequency fluctuations with the known grid frequency variations. This comparison enables us to pinpoint the exact time the recording was made.

Earlier grid frequency data had to be recorded manually by plugging a recording device into the mains. Recently, the National Grid ESO, the organization responsible for operating high-voltage electricity transmission networks in Great Britain, released its grid frequency data, which was recorded right at the source for a period of around 10 years.



System Frequency

This page holds the historic system frequency data for Great Britain at a 1 second resolution. It is the role of the National Grid ESO to keep the system frequency at 50 Hz, with a statutory limit of 0.5 Hz above or below this value. Time values are all given in Greenwich Mean Time (GMT) starting January 2020.

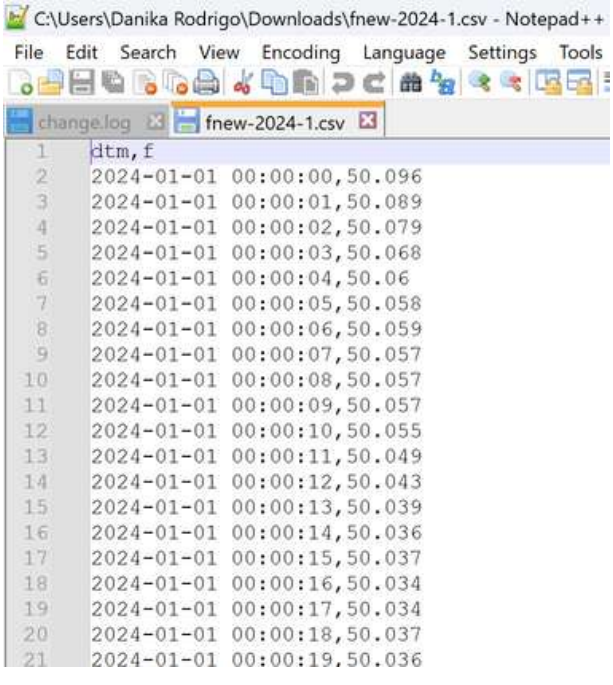
NOTE: Due to the size and format of these files, to view the data, please download the CSV file and open it with Notepad++ for complete document loading.

System

121 Data Files

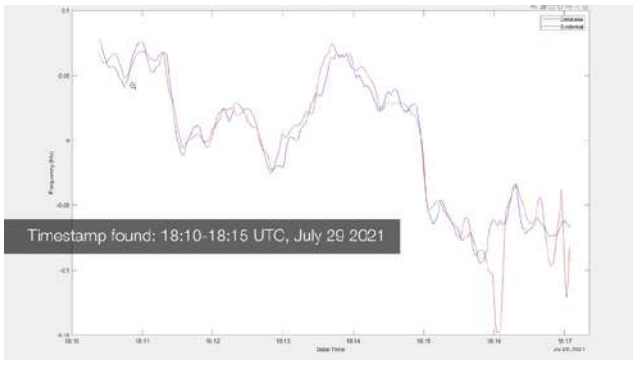
Name	Format	Last Changed
January 2024 – Historic Frequency Data	CSV	4 days ago
December 2023 – Historic Frequency Data	CSV	1 month ago
November 2023 – Historic Frequency Data	CSV	2 months ago

Grid frequency data is obtained from www.nationalgrideso.com.



Variation of national grid frequency on 1st of January 2024

The diagram below shows the variation of grid frequency of the 50Hz component extracted from sample audio with the actual data provided by the National Grid ESO.



If we know that the recording has been taken within a certain timeframe, determining the exact time would be convenient; otherwise, the whole data set would need to be analyzed, which would be a time-consuming process. Typically, frequency exhibits continuous variation over time; hence, a sudden deviation in frequency patterns could indicate tampering with the audio file or the recorder moving away from the ENF source. Such nuances could be pivotal when presenting evidence in court.

Although the concept of ENF analysis may sound spellbinding at first glance, it is important to acknowledge its limitations. At certain times, the "mains hum" may be completely inaudible, or the sample clip may be too short to match the variations with the data obtained from the grid fluctuations. Regardless of these limitations, this method stands as a remarkable feat of technology, showcasing the creativity and innovation brought about by humans in the field of audio forensics. Tools like ENF analysis help uncover hidden truths that would otherwise be buried among false accusations, delivering justice to the innocent. This technology has the potential to greatly improve forensic investigations and ultimately contribute to societal improvement with further development. It illustrates how unintentional discoveries like this might result in changes to the use of technology for the benefit of society.

FAST CHARGING, THE TIME SAVER

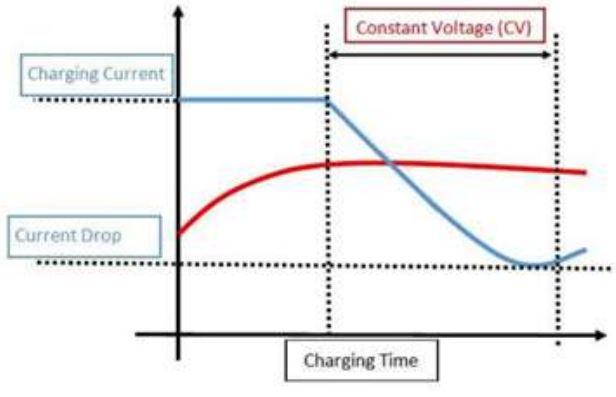
Sulith Perera
21 Batch

> **Can fast charging be the ultimate time-saver for electric vehicles?**

The world is moving toward electric vehicles because of concerns about resource depletion, public health, and environmental sustainability. However, the primary limitation of electric cars is their restricted range on a single battery charge. When gasoline or diesel runs out in cars powered by fossil fuels, we can refuel in a few minutes. However, electric vehicles require several hours to recharge. As a result of the numerous studies conducted to address this problem, an electric vehicle fast charger was created.

When you hear the name fast charger, the first thing that comes to mind is a mobile phone charger or laptop charger. However, electric vehicle chargers have concerns about thermal management and the amount of power delivered to the battery when compared with mobile phone or laptop chargers. DC fast charging, ultra-fast charging, wireless charging, supercapacitors, etc.,

are the current technologies used to fast-charge electric vehicles. But DC fast charging is the most widely used method all around the world.



Batteries for electric vehicles go through two charging stages, just like a mobile phone charger. The two phases are the constant voltage phase and the constant current phase. The battery receives constant current until it reaches 80% of its maximum capacity. Once the battery reaches 80%, the charger switches to constant voltage mode, safely delivering a lower current to top off the battery.

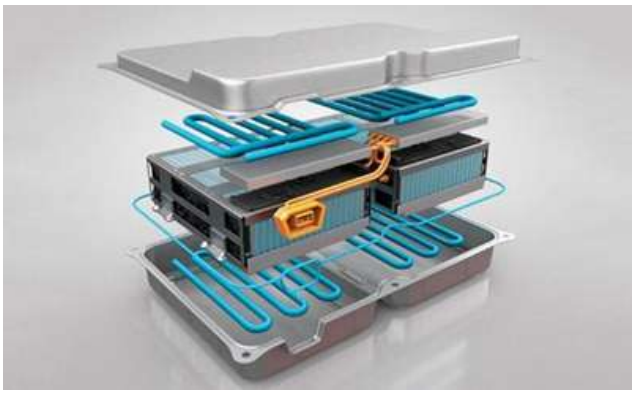
As you know, the electricity available in local grids is in the form of alternate voltage and current. An electric vehicle has an onboard AC-to-DC converter that converts AC current and voltage to DC current and voltage. However, this conversion process takes a lot of time, making the charging process much slower. To overcome this issue, the new fast chargers in the market supply DC current directly to the vehicle, bypassing the converting system. To convert AC to DC inside the charger, a technology called switching power supply (SMPS) is used.

Depending on conditions, these DC fast chargers can deliver power at a 50 kW to 350 kW rate. The conditions depend on the data

gathered from the electric vehicle. Because of its high-power output, a DC fast charger can charge a battery from 20% to 80% in as little as 20 to 30 minutes. Currently, the DC fast charger is not used at the domestic level due to its high cost and infrastructure requirements, such as specialized wiring designs and upgrades to the main electric panel. They are mostly used in highways, rest areas, urban areas, workplaces, etc.

To simplify vehicle design, most current electric vehicles have a single charging port that can handle both DC and AC charging. Most modern electric cars are equipped with a Combined Charging System (CCS) port, a standardized connector compatible with AC and DC chargers. As the electric vehicle's onboard AC to DC converter must be bypassed, it is essential to figure out what kind of charger the car is connected to. For that, the charger and the car communicate with the charger using a unique protocol. Protocols exchange information like voltage and current levels, the state of charge (SOC) of the battery and the vehicle's charging status (charging, paused, or completed). ISO 15118 protocol is used for bidirectional communication between electric vehicles and the grid, as electric vehicles are used as energy storage devices in developed countries.

The charger can adjust the power output to match the car's safe charging capabilities and limits based on the data it receives from the vehicle. For instance, the charger may lower the power delivery to avoid overheating or damage if the car's battery is almost full or the temperature is high. DC fast chargers regularly communicate with the battery cooling system to dissipate heat produced during the charging process. Efficient cooling is crucial to maintain safe operating temperatures and ensure the longevity of both the charger and the electric vehicle's battery.



Fast charging has disadvantages even if it allows us to charge the electric car faster. One of the main issues is the impact on the vehicle's battery life. The high-power delivery and heat generation can accelerate battery degradation over time. Due to that, reliance on slower AC charging for regular top-ups is recommended for optimal battery health. Another significant drawback of fast chargers is their increased equipment and installation costs. So it is essential to use fast chargers only when they are needed.

INTELLIGENT AUTOMATION WITH ARTIFICIAL INTELLIGENCE

Shapthamuky Jeevakaran
21 Batch

> **AI streamlines industries, prompts ethical concerns. Collaboration essential for harmonious human-AI future.**

For centuries, humans have dreamt of a world where machines perform all the powerful tasks, allowing them to achieve their ambitious targets. Now, with the advancements of Intelligent Automation empowered by Artificial Intelligence (AI), that dream is becoming closer to reality. Imagine a world where the robots do repetitive tasks, make insightful decisions, adapt to changing environments, and learn from their mistakes. This is not just automation; only intelligent automation with artificial intelligence has the capability to reshape industries and redefine the human workforce. Unlike basic automation, intelligent automation performs repetitive tasks that include complex processes with AI algorithms to analyze data, predict outcomes, and modify conditions as needed. This enhances workflows and decision-making capacity and increases the process's efficiency. However, this revolution never happens overnight. We have to move forward with mindful steps, ensuring no human gets lost in this automation shuffle.

What is Intelligent Automation?

Intelligent Automation is the combination of Artificial Intelligence, Machine learning and Process automation to automate processes and tasks traditionally performed by humans. Applying intelligent automation in industries can increase efficiency and productivity, improve accuracy and quality control, enhance customer services and decision-making, and control operational costs.

Intelligent automation uses several technologies to achieve necessary functionalities, but there are five basic components which make intelligent automation possible. They are Artificial Intelligence, Robotic process automation, Business process management, Automation tools and Data. Although these five components are considered as the basic components, “Artificial Intelligence” plays a major role in the operation. Let’s go deeply into this part.

Artificial Intelligence

Artificial intelligence, commonly known as AI, enables machines to perform human-like intelligence such as learning, reasoning, problem-solving and decision-making. These are achieved by using different techniques like machine learning, natural language processing and computer vision.

- Machine Learning (ML): A type of AI that uses algorithms to learn from collected data.
- Natural Language Processing (NLP): A machine's ability to identify, understand and output spoken and written human language.
- Computer Vision: The ability of a machine to understand and analyze visual information from the real world.

Applications of AI powered Intelligent Automation are there in various fields like healthcare, finance, manufacturing, entertainment, etc. Let’s focus on some of them.

Healthcare

Medical scans and patient data are analyzed by AI-powered medical tools with the highest accuracy, capable of identifying illnesses early and suggesting treatment plans. Robotic surgeons, assisted by AI algorithms, perform complex procedures with high precision and minimizes risks.

Finance

Fraud detection systems are now AI-driven, which can detect suspicious activities in milliseconds, ensure the safety of financial institutions, and protect customer assets. Algorithmic trading platforms analyze market data, quickly identify trends, and execute suitable investment strategies.

Manufacturing

In factories, AI-powered robots make informed decisions, predict equipment failures before they happen, and optimize production lines in real-time. These reduce downtime, improve efficiency and personalize product specifications based on customer preferences.

Retail

Natural language processing chatbots provide customized suggestions, solve issues efficiently, and provide a perfect purchasing experience by understanding customers' questions. Intelligent inventory management systems predict demand and improve supply networks to reduce waste and ensure product availability.

These are just some examples of those applications. Intelligent automation is leaving its mark in almost every industry, from transforming customer services with AI-powered virtual assistants to self-driving vehicles.

Although there are plenty of benefits from AI-powered intelligent automation, there is a common fear among people. That is the possibility of unemployment. But the truth is, the development of intelligent automation doesn't mean that it will be the end of human jobs; it will lead to a new collaborative working environment. As machines take over repetitive tasks, humans will be reskilled and refocused on creativity, innovation and strategic thinking. This human-AI combination may lead to reaching the highest level of productivity, innovation and value creation.

While the importance of intelligent automation is significant, it also has some challenges, such as ethical concerns, job displacement, and transparency and explainability. Bias is AI can cause discrimination and poor outcomes. We must prioritize responsible AI development, considering ethical issues at all stages of the process. When we consider job displacement, while new jobs will be created, some existing jobs may be outdated. Governments and educational industries must work together to provide reskilling and upskilling projects to facilitate a smooth transfer in the workforce. Moreover, AI decisions should be clear and explainable, as building trust in AI through clear communication and responsible use will be important.

Hence, engaging with intelligent automation and overcoming its challenges require a significant effort. To build a better society, we need to collaborate with humans and AI, where technology helps us overcome limitations and realize our potential. Continuous learning and a human-centric approach are more important for this process. By considering these, we can ensure that intelligent automation will become a force that creates a better future with the combination of humans and machines.

LATEST ADVANCEMENTS IN ELECTRICAL ENGINEERING

Gihansa Kurukulasooriya
22 Batch

> **Latest breakthroughs from renewables to medical marvels, explore innovations energizing our future.**

The field of electrical engineering has recently seen tremendous advancements, resulting in a technological boom that has benefited various sectors, including robotics, medicine, and power generation. Since the discovery of the practical application of electricity in the 18th century, we now enjoy thousands of innovations in our daily lives. Some of the latest developments include smart devices, virtual reality technology, and more efficient power generation methods.

As the availability of fossil energy sources is dwindling, the scarcity of energy is becoming one of the biggest challenges we face today. Therefore, we increasingly rely on renewable energy resources to meet our energy demands. Fortunately, recent advancements in electrical engineering have introduced several methods to generate renewable energy.

Recently, a French start-up company, “Unéole”, has developed an idea that uses solar and wind power in a single unit. This is designed to be used on flat roofs and to use multiple silent wind turbines under a photovoltaic roof. This can produce 40% more energy than an ordinary panel and generate power the whole day, not limited only to daytime.

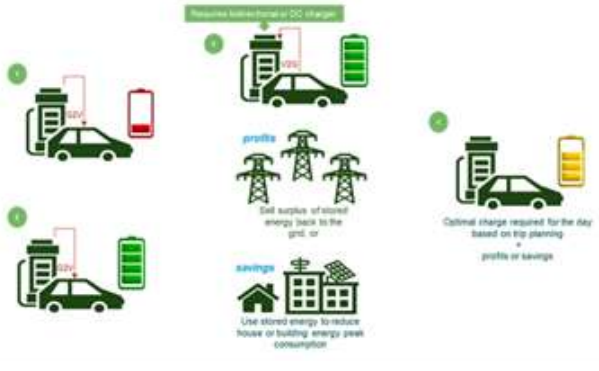
In California, people experience droughts. As an option for that, a start-up company called “SolarAquaGrid” is trialing a way to reduce evaporation and generate power by roofing over the canals with solar panels. The World Economic Forum says that if all 6,400 km of the state’s canals were fitted, it’s forecast to save 283 billion liters of water a year and generate power for 9.4 million homes.

Nowadays, water scarcity is a huge problem. According to UNICEF, almost two-thirds of the world’s population is affected by it for at least one month each year. As an option,off-grid

“hydro panels” are suggested, which turn the air into water. After mineralizing, that water can also be used for drinking. These hydro panels have been installed in 50 countries so far.

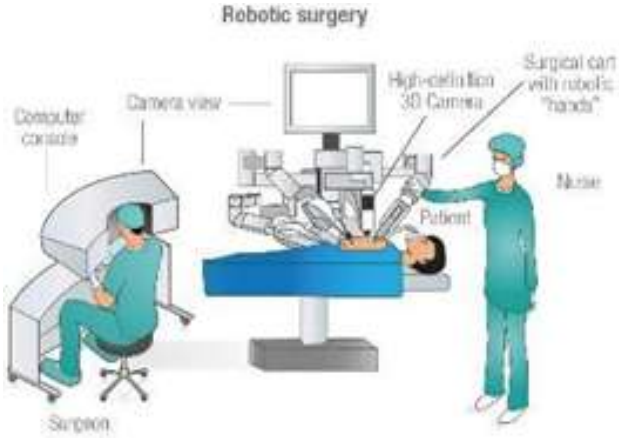
There have been key innovations in storing energy, too. Traditional lithium-ion batteries are going to be replaced by lithium-sulfur batteries, which can be used as an alternative to lithium-ion batteries. Since they have more energy density, they can store more energy for the same weight. Also, rechargeable flow batteries keep the energy stored in liquid electrolytes, so they have longer life cycles. This is suitable for grid-scale energy storage applications. A solid-state battery is a good innovation that has faster charging and a higher energy density.

Transportation methods are also electrified. Battery-electric vehicles and plug-in hybrid vehicles are designed to use electricity as the primary source of energy while reducing the dependence on fossil fuels. This also reduces greenhouse gas emissions. Have you ever heard about how electric vehicles can power the grid? This amazing new technology is known as V2G (vehicle-to-grid) technology. This enables electric vehicles not only to receive energy from the grid but also to return the excess energy to the grid. This provides support to the grid during peak hours and also increases its flexibility.



How V2G Works
(Source - https://www.mdpi.com/1996-1073/15/8/2861) [1]

Many innovations have been introduced recently in the medical industry. Now, the surgeries could be performed more efficiently using robotic hands. This reduces the scars, blood loss, and risks of infection while reducing the recovery period. This robot's hands can access a wide range of organs for a wide range of health conditions, and the surgeon can access a detailed and magnified view of the surgical site. Do you know that our emotions can be understood by technological devices? By using a vocal bio-maker, we can detect some mental disorders, such as depression and anxiety.



A lot of innovations have been introduced to make our day-to-day lives easier and more efficient. You have probably seen a lot of smart devices on the market, such as smart watches, smart belts, and smart rings. Using smartwatches. These are used for multiple purposes.

“hydro panels” are suggested, which turn the air into water. After mineralizing, that water can also be used for drinking. These hydro panels have been installed in 50 countries so far. There have been key innovations in storing energy, too. Traditional lithium-ion batteries are going to be replaced by lithium-sulfur batteries, which can be used as an alternative to lithium-ion batteries. Since they have more energy density, they can store more energy for the same weight. Also, rechargeable flow batteries keep the energy stored in liquid electrolytes, so they have longer life cycles. This is suitable for grid-scale energy storage applications. A solid-state battery is a good innovation that has faster charging and a higher energy density.
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In conclusion, electrical engineering has led to countless advancements, recently starting a whole new era of technology that will continue to produce wonderful innovations that we can't even imagine in the future.

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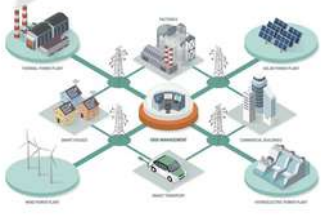
MICROGRID REVOLUTION: AI TAKES THE WHEEL OF FUTURE ENERGY DISTRIBUTION

Gayanuka Amarasuriya
21 Batch

> **Ever wondered about the intersection of AI and microgrids?**

The Power Shift

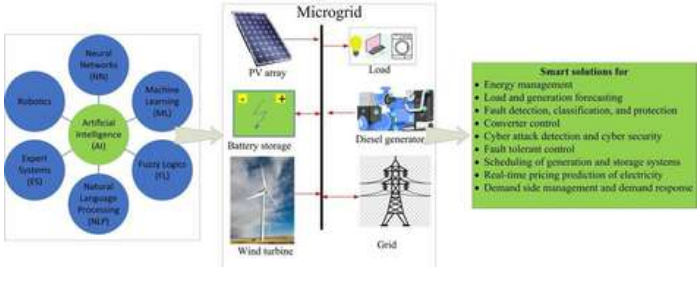
Imagine a future where power isn't delivered from faraway plants but made where you live! Microgrids, like tiny, self-sufficient power stations, are changing the game. These make energy more adaptable and reliable for businesses and communities. But the coolest part is now here. These microgrids are getting smarter with the help of artificial intelligence. By adding AI smart tech to these microgrids, we unlock a world of possibilities. The energy adjusts to your needs and distributes it in a smarter way. So, get ready for the microgrid revolution. One that is powered by AI and is about to rewrite the energy landscape for a more sustainable future!



The Symphony of Intelligence

For decades, massive power grids have been the backbone of our energy supply. They kept lights on in cities and remote villages alike. However, these traditional systems have limitations. These power grids can't easily adapt to changing needs. Also, they're prone to outages from weather or cyber-attacks. They also have trouble using clean energy sources like solar or wind power. Microgrids are the game-changers in this energy landscape. AI acts like a smart brain for microgrids. They analyze real-time data and user preferences. This provides intelligent energy management, optimizes energy use, and minimizes downtime. For instance, AI can automatically adjust power usage during peak hours. At high demand response, this maintains grid stability. Additionally, AI can detect and isolate faults within the microgrid. This minimizes disruptions. So, let's delve deeper into the exciting possibilities of AI-powered microgrids. To explore how they are revolutionizing the future of energy distribution.

Powering Possibilities



Smart Solutions for Microgrids
(Source - https://www.mdpi.com/1996-1073/15/8/2861) [4]

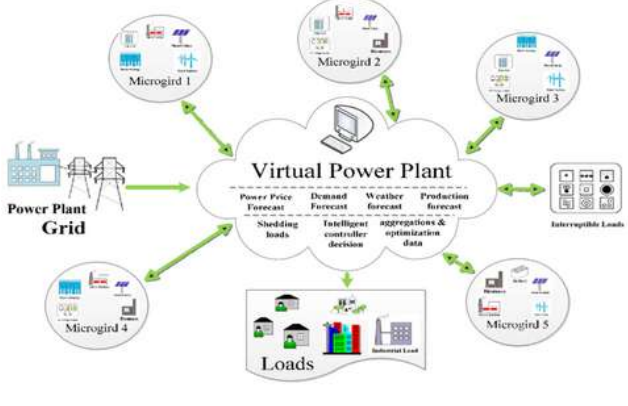
The rise of climate change and evolving technology make AI microgrids a beacon of hope. These aren't just backup power sources. But a glimpse into a more sustainable future. Where entire communities are powered by clean, locally-sourced energy like sunshine and wind. AI acts like the conductor in this energy orchestra. It can seamlessly combine renewables and adjusting power based on real-time needs. This reduces our dependence on fossil fuels. Perhaps the most transformative aspect lies in uplifting remote populations. According to the World Bank, millions of people globally lack access to electricity. These smart grids present a powerful solution for bringing affordable and dependable

electricity. They hold the key to unlocking a future. One where everyone has access to affordable, reliable, and sustainable energy. The potential for economic growth grows with a brighter future for all.

The Road Ahead

The path towards an AI-powered energy future has both possibilities and challenges. The integration of AI promises a significant transformation. However, hurdles like data security and privacy concerns remain. The initial costs of setting up can also be a barrier. Recognizing these obstacles is crucial as we navigate this uncharted territory. The energy sector is blooming with exciting developments. For instance, a pilot project in Kenya by Powerhive. This company deployed an AI-powered microgrid at a lower cost. This demonstrates the potential for cost reductions as the technology matures. Research continues to unlock the full potential of AI. As AI gets more sophisticated, microgrids could completely change how we get our electricity. This would benefit both communities and the environment.

A Promising AI Horizon



The future of energy is getting smarter! Merging AI with microgrids unlocks incredible potential. Just think about your local power grid learning and adapting in real time. As we explore this promising AI horizon. So don't fall behind; stay updated with these latest trends. The potential for a brighter energy future feels closer than ever.

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PRACTICAL APPROACHES TO MAKE A SUSTAINABLE AND RESILIENT ENERGY SYSTEM IN SRI LANKA

Tharindu Hemantha
21 Batch

> **Harnessing renewable energy sources paves the path to a brighter, greener future.**

Energy is the essence of any economy. In Sri Lanka, there is a greater need than ever for a sustainable and resilient energy solution due to the current monetary crisis. Finding practical solutions is challenging as suitability is crucial for balancing economic growth with environmental sustainability. Various approaches satisfy suitability, such as harnessing all possible renewable energy sources. These approaches cover Sri Lanka's energy needs and contribute to economic recovery and long-term resilience.

1)Effectively utilising the available renewable energy sources

Sri Lanka is a country that can easily transition to renewable energy. For example, the hundred-megawatt Mannar wind power generation project is being developed methodically. Some recent interventions include the thirty-point-five-megawatt Moragolla hydropower plant and its supporting infrastructure, a credit line facility to install sixty megawatts of solar rooftop capacity, and the development of potential renewable parks at Siyambalanduwa, Pooneryn, and Mannar phase two. In addition, there have been numerous Asian Development Bank projects in the past that supported the development of sustainable energy. So those are the already existing and innovative practical approaches. In the Sri Lankan context, marine and hydrokinetic energy, a highly underutilised renewable energy source, should not be neglected. Unfortunately, this energy exists in the pre-commercial stage. Despite multiple practical barriers, such as the high cost of inverters, efforts must focus on securing funding and encouraging researchers and partners. These approaches can create new job opportunities, especially related to tourism. This can reduce the dependency on imported fossil fuels, which is the main reason for the intermittent power supply issues that people face occasionally.

2) Suitable pipelining method

Suitable pipeline methods for energy projects are crucial. If not, the funding will not be properly allocated to the essential projects. Researching the project ideas and ongoing projects must be a must to define their potential. A country must use its brains, which are specialised in the relevant fields. When developing a new project, identifying the needs of the locals, understanding the existing rules and regulations, and finding proper partners are important. Examples of existing approaches include projects from the United States Agency for International Development, solar rooftop projects supported by the Asian Development Bank, and wind power projects by the Adani group. It can create several jobs and attract more foreign investments.

3) Proper rules and regulations

Proper rules and regulations, especially the tariff-settings process, are important for a sustainable and resilient energy system. In recent examples, the restructuring of the power sector has improved the regulations towards sustainability, such as successful power generation, minimising distribution losses, and giving wide access to the grid. It has failed to establish a comfortable tariff cost-charging system. It is necessary to manage the tariff cost-charging system for resiliency and sustainability. According to the executive summary

of Sri Lanka's energy infrastructure sector assessment program, which the World Bank Group did, Sri Lanka has faced several challenges in developing large-scale non-conventional renewable energy projects. However, the country has the potential to make renewable energy mainly due to the high tariffs. Another issue mentioned is poor commercial finance.

4)Effective waste management system

Countries like Sweden, Norway, Denmark, and Oman have built efficient and exemplary waste management systems. They use their waste as energy sources. There is a great need to visit these countries, learn from their knowledge and technologies, and invite global and local investors to encourage relevant developments. Implementing those techniques in urban areas such as Colombo, Kandy, Gampaha, and Rathnapura is practical. An effective waste management system can provide multiple advantages. Since energy is a hundred percent green and carbon emission is getting very low, the contribution of air pollution and global warming is getting low. By recovering valuable resources, we can save our money and planet—especially metals from electronic waste. Building a productive waste management system also creates job opportunities in the power industry. Therefore, the resiliency of the system will increase.

5) Local and community involvement

Local and community engagement is pivotal in successfully implementing sustainable energy practices, focusing on collaboration between local energy authorities and communities. The commitment to prioritise affordable, environmentally friendly, clean energy over profit is essential. This dedication contributes to the development of adequate energy and climate policies. Additionally, distributing the benefits of sustainable energy within the community, such as allowing consumers to participate in power generation and earn from selling clean energy, fosters a more inclusive approach. Encouraging the use of electric vehicles through tax reductions and supporting local researchers in clean energy experiments is crucial for reducing dependence on external knowledge and preventing brain drain. Ultimately, government motivation is key to driving these sustainable initiatives.

PURSUING 100% RENEWABLE ENERGY: FEASIBILITY, CHALLENGES, AND THE DRIVE FOR A SUSTAINABLE FUTURE

Buddisha Dissanayake
20 Batch

> **Sri Lanka's Renewable Energy, Shaping Sustainable Tomorrow**

Energy crises have become an inevitable concern in today's global landscape, impacting many core domains of the world's economy and social welfare. This has drawn attention to renewable energy sources as a contemporary solution, given their availability, environmental friendliness, and cost-effectiveness compared to most non-renewable energy sources.

Sri Lanka, a country severely affected by the recent energy crisis, has seen numerous discussions regarding the feasibility of transitioning to 100% renewable energy for electrical power generation. While the idea of generating power through renewable sources may appear to be the best option available, integrating new and existing systems requires careful evaluation of feasibility to identify the potential pros and cons.

With the aim of achieving 100% renewable energy by 2050, Sri Lanka intends to reduce dependence on imported energy supplies. This has the advantage of conserving foreign exchange reserves and paving the way for industrial and social progress.

Although the adoption of 100% renewable energy offers economic, environmental, and social benefits, it also raises concerns that need attention. The transition is not as straightforward as shifting from non-renewable to renewable sources; it involves various steps of system integration and restoration, necessitating significant investments.

According to a 2017 report by the Asian Development Bank titled "100% Electricity Generation through Renewable Energy by 2050: Assessment of Sri Lanka's Power Sector," seven key challenges are identified:

1. There is a need for substantial investment in power sector infrastructure (generation, transmission, and distribution).
2. Technical challenges related to the inadequacy of ancillary systems to support the grid in a high renewable energy (RE) scenario.
3. Insufficient incentives for developing RE-based capacity.
4. The high cost of electricity from RE sources acts as a deterrent to new capacity development.
5. Limited local research and development to promote capacity development.
6. Slow development of rooftop solar due to consumer education gaps and limited low-cost financing options.
7. Dependency on hydro plants for electricity leaves the sector vulnerable to variability in the monsoon pattern.

Aside from the increasing installation of rooftop solar, other challenges persist, especially amidst the recent energy crisis and economic downturn, intensifying the difficulty of achieving the target.

Transitioning to 100% renewable energy also poses technical challenges for integrating into the existing grid system, requiring immediate attention. The widespread adoption of renewable energy is expected to result in a

fluctuating power supply, necessitating a robust ancillary system for effective management. Pumped Storage Power Generation (PSPP) infrastructure will be crucial in addressing peak and off-peak demands.

Another challenge is the limited availability of research facilities dedicated to renewable energy development, making the industry highly reliant on importing expertise and resources. The lack of domestic funding for such projects complicates the transition.

Nevertheless, Sri Lanka's goal of achieving 100% renewable energy by 2050 is commendable. As a country abundant in renewable energy sources, achieving this goal is feasible with proper resource management and execution.

REVOLUTIONIZING RENEWABLE ENERGY WITH FLYWHEEL ENERGY STORAGE SOLUTIONS

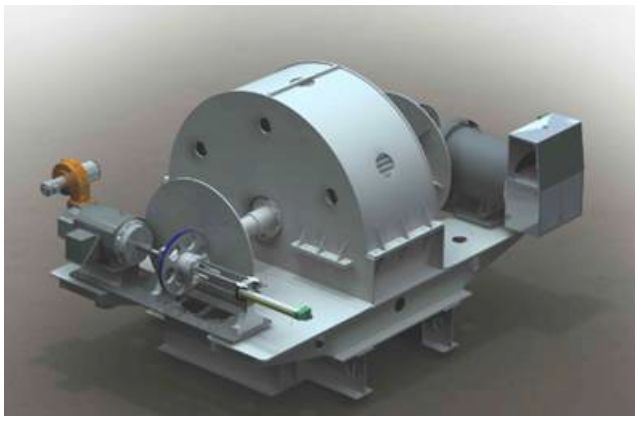
Tharindie Pilapitiya
21 Batch

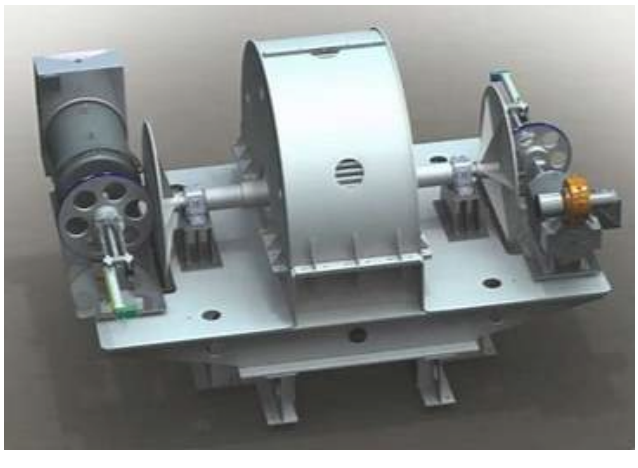
What is the impact of FESS on renewable energy integration?

Over the past decade, substantial advancements have been made in renewable energy technologies, particularly in wind and solar. However, they are not independent and reliable due to their intermittent nature. Energy Storage Systems are crucial in storing intermittent renewable energy, thus creating a continuous supply for micro-grids. Among these systems, the Flywheel stands out as an ideal energy storage solution, offering benefits such as elevated energy efficiency, rapid response speed, robust instantaneous power, minimal maintenance, extended lifespan, wide operating temperature range and environmental friendliness. Nevertheless, superconducting Flywheel Energy Storage Systems (FESS) require cryogenic cooling devices, impacting capital investment.

Fess structure

The Motor First, let's talk about the motor. Potential energy is transformed into kinetic energy by the motor. You may believe that there are many different kinds of motors, and reading through all the pages about various petrol engine types may lead you to believe that, but there are really just two main kinds of motors. This has always been the case throughout human history. The heat engine is the first type of motor, and the electric engine is the second.





Rotor

A few years back, steel was the primary material used, but high-speed applications were not allowed due to its inability to withstand the load. Subsequently, titanium or aluminum alloys were employed. The latest solution is composite materials, enabling the development of speeds up to 100,000 rpm and achieving high-power density simultaneously. The stored kinetic energy is calculated in the following manner.

$$E = \frac{1}{2} J \omega^2$$

$$J = \int r^2 . dm \ = mr^2$$

Here, J represents the moment of inertia, ω represents angular velocity, m is the mass of the cylinder, and r is the radius.

Motor/generator

During the motor operation phase, energy is conveyed to the flywheel, charging the energy-storing system. Conversely, when operating as a generator, the FESS undergoes discharge, utilizing the stored kinetic energy to generate electrical power.

Bearing

Bearing design is important as it impacts losses and maintenance needs. Mechanical bearings, the initial bearing type, exhibit high friction and limited lifespan, necessitating lubrication and regular maintenance due to wear. The magnetic bearings introduced advantages such as extended lifespan, quick response, substantial load capacity, minimal losses and suitability for high-speed applications. However, they have a complicated control system. If magnetic bearings fail or are loaded excessively, FESSs still necessitate secondary mechanical bearings.

Power electronic interface

Advancements in power electronics have made the frequency and amplitude control of voltage easier. With this, an innovative approach for electrical energy storage is introduced by connecting a power converter and electrical motor to a Flywheel.

Applications

Power sector

FES can address short-term and random demand fluctuations, eliminating the necessity for frequency control. Additionally, FES provides "ride through" capabilities during brief power interruptions, reduces harmonic distortions and eliminates voltage dips and spikes.

It handles daily demand curve peaks by storing surplus electricity generated during low-demand hours to fulfil a surge in demand. Flywheels offer a solution for regional storage of electricity output by variable sources like wind and solar, mitigating the requirement for downstream power electronics to monitor variations and thereby enhancing total efficiency. FES extend electricity access to populations without a grid connection.

Defense

Their capability to deliver and manage high-power output makes Flywheel systems versatile in diverse and advanced applications, from electromagnetic launchers to support the energy demands of cutting-edge laser weaponry and nuclear fusion initiatives.

Aerospace

Research takes place on the potential replacement of Li-ion batteries with astronautical FESS. Flywheel's high-power rating and extended lifespan are beneficial for satellites and space stations. The application of FESS in satellite attitude control is a significant focus. The low specific energy of flywheels makes them less suitable for onboard use but suitable during take-off and landing.

Marine

With diverse operating conditions, power quality in ship networks undergoes frequent and wide-ranging fluctuations. To enhance the power quality, FESSs have been specifically designed as auxiliary components.

Vehicles

The fundamental concept behind integrating FES into vehicles lies in supplying the average power required for propulsion through the engine, while brief spikes in power needed for tasks like climbing hills and acceleration are drawn from the FES. When the vehicle decelerates, this energy can be restored directly by the engine or through regenerative braking, which converts kinetic energy into stored energy without wasting. Incorporating high-velocity small-sized flywheels (rotating at 64,000 rpm) have been introduced since the 2000s, notably in Formula One race cars. However, these add significant weight to vehicles.

Railway

Incorporating FW with electrical transmissions enables more flexible power operations in commuter trains that rely on electrical energy for propulsion. The regenerative braking converts its kinetic energy into electricity, which is then efficiently returned to the power grid quickly or stored for later use.

THE MARVEL AND CHALLENGES OF NUCLEAR BATTERIES

Gevindu Kalansooriya
19 Batch

> **Merging nuclear principles with modern energy**

Innovations in the ever-evolving field of electrical engineering are redefining the landscape of power sources. The nuclear battery is an innovative technology that has drawn interest from specialists and enthusiasts. Nuclear batteries are an interesting example of how power and innovation may come together by fusing the principles of nuclear research with the requirements of contemporary energy needs. Nuclear batteries convert the energy of radioactive decay into electrical energy. There are mainly two ways in which nuclear batteries allow direct harnessing of nuclear energy from radioactive decay: thermal and non-thermal. Selecting suitable radioisotope material is very important while developing the nuclear battery. Alpha and beta emitters are typically used as radioisotopes for nuclear battery applications.

When it comes to alternative energy sources, nuclear batteries are unique because of their many benefits. Their outstanding energy density is the main benefit. Nuclear batteries provide electricity by the continuous radioactive decay of isotopes, in contrast to conventional batteries that rely on chemical processes. Because of this intrinsic quality, nuclear batteries have a long lifespan and are a dependable and sustainable source of energy.

Recently, Beijing Betavolt New Energy Technology Company Ltd announced the creation of a small atomic energy battery that can produce power steadily and independently for 50 years without the need for maintenance or charging. It stated that the battery is presently in the trial program and would soon be available for purchase in large quantities. According to Betavolt, their batteries can provide a stable power source for a variety of applications, including micro-electromechanical systems, sophisticated sensors, tiny drones, micro-robots, aerospace, AI, and medical equipment. "If policies allow, atomic energy batteries can allow a mobile phone to never be charged, and drones that can only fly for 15 minutes can fly continuously," it stated. This gives a clear indication of the potential possibilities of nuclear batteries.

Nuclear batteries have drawbacks, even with their intriguing benefits. The public's perception and safety are the main areas of concern. Large-scale adoption of this technology has been hesitant due to concerns of leakage and mishaps stemming from the use of radioactive elements in nuclear batteries. To address these issues and increase public confidence in the dependability and safety of nuclear batteries, strict safety regulations and extensive public education are needed. The significant upfront costs associated with developing and producing nuclear batteries are another disadvantage. The high expense of widespread adoption is attributed to the intricacy of managing radioactive materials and the specialized technologies required. It is expected that economies of scale will reduce prices and make nuclear batteries a more economically feasible choice as research and development continue.

To sum up, nuclear batteries are an incredible advancement towards high-density, sustainable energy sources. Their benefits, such as long lifespan, high power production, and environmental friendliness, make them an appealing choice for a range of uses. However, realizing the full potential of nuclear batteries would require overcoming safety issues and cutting production costs. As long as technology keeps developing, nuclear batteries have the potential to play a major role in determining how energy is produced in the future.

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THE ROLE OF EFFICIENT ELECTRICAL APPLIANCES FOR SUSTAINABLE DEVELOPMENT

Budara Abeysinghe
21 Batch

> **Efficient electrical appliances are driving sustainability forward, one watt at a time.**

The United Nations Conference on Sustainable Development in Rio de Janeiro 2012 adopted "Transforming our world: the 2030 Agenda for Sustainable Development," making sustainable development a top priority for all nations. It includes economic growth, social well-being, and environmental conservation. A nation must utilize energy with a maximum return on investment to meet sustainability. As a result, many governments have made increasing electrical appliance energy efficiency their top concern. Energy-efficient electrical appliances use less energy to run at the same capacity as other appliances. With benefits ranging from lower energy costs to longer product lifetimes, these appliances are revolutionizing energy consumption and conservation.

Economic Benefits

Efficient electrical appliances are designed to use less energy. The use of them lowers energy costs for individuals and enhances the productivity of households. Reduction of utility costs increases their disposable income. Thus, increases consumer spending, which further advances economic development. In addition, it reduces the nation's energy spending. As a result, money savings can be put back into more development initiatives. Reducing daily energy consumption improves energy security by lowering a nation's reliance on energy imports. A country can, therefore, depend more on its domestic energy sources.

To promote economic growth, lower poverty, and strengthen social cohesion, job opportunities must be created. Continuous research, technical support, and labour are needed to develop efficient appliances with existing conservative appliances. Government and private sector companies can invest in developing and producing energy-efficient appliances and create job opportunities in manufacturing, sales, and maintenance.

Environmental Benefits

The role of energy-efficient appliances extends to preserving the environment, contributing to reduced greenhouse gas emissions, electricity-generating resource preservation and e-waste reduction. Lower energy consumption of efficient electrical appliances reduces the need for fossil fuels and other natural resources used for electricity generation in a country. When energy production requirements are less, the use of thermal power plants can be reduced, mitigating their harmful environmental impact. This contributes to alleviating climate change. In addition, it benefits public health, local ecosystems, and wildlife, promoting environmental sustainability.

Electrical and electronic waste has become a prominent issue, with fewer e-waste management systems in many countries. It is the fastest-growing waste stream, which is hazardous and costly to treat. Efficient appliances tend to have longer lifespans and produce less electronic waste, as they are replaced less frequently. Sustainable materials are often used in energy-efficient appliances. Therefore, many of these items can be recycled when their useful lifetime ends. This contributes to a reduction in waste and its associated environmental impact.

Factors Affecting the Adoption of Energy-Efficient Products

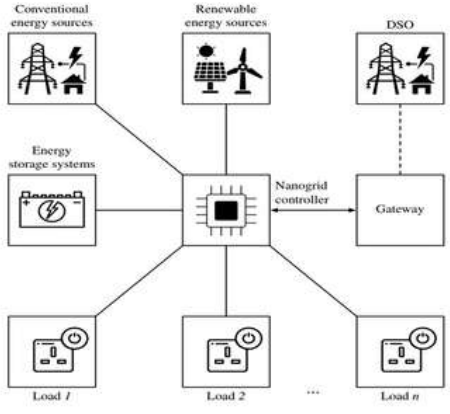
Affordability, perceived usefulness, attitudes and ease of use affect the choice of citizens. The high cost of energy-efficient appliances is a potential reason that holds people back from purchasing them. As a solution, governments can offer incentives and rebates. That will encourage consumers to buy them. Governments can establish and enforce energy efficiency requirements for home appliances. The energy efficiency of an appliance is indicated by the Energy Star labelling scheme. It is possible to run awareness campaigns to inform customers about the Energy Star labels and their advantages in terms of safety, health, and money savings. As a result, armed with knowledge of contemporary technologies and the laws and regulations governing electrical appliances, citizens can make well-informed decisions when buying these appliances.

According to the U.S. Department of Energy, the average household can save up to $500 a year by switching to energy-efficient appliances. In conclusion, energy-efficient home appliances can lower energy use, which promotes financial savings, economic expansion, and environmental preservation. As a result, effective electrical appliances are essential to a nation's efforts to develop sustainably. The demand for energy-efficient appliances is expected to rise significantly in the coming years as people adopt more environmentally friendly lifestyles and grow more conscious of their roles in addressing climate change. For a greener future, the government and relevant authorities should support and encourage using energy-efficient electrical appliances and invest in energy-efficient technologies. Consumers must work together and prioritize using these appliances to build a better, more sustainable future for the nation. Eventually, this may contribute to an increase in the global energy efficiency improvement rate by 2030, meeting sustainable development goal 7.

THE ROLE OF NANO GRIDS IN SUSTAINABLE ENERGY TRANSITION

Sandaru Dias
21 Batch

> **Nano grids, Sparking Energy Independence, Illuminating Sustainable Futures.**



Typical structure of a nanogrid distribution system
(Source - https://www.mdpi.com/1996-1073/15/8/2861) [1]

Nano grids are a novel concept that has developed in the changing environment of energy generation and delivery. A nano grid is a small-scale energy system that may work with the local main electrical grid or independently. These compact energy systems are an effective way to produce sustainable energy since they are adaptable, efficient, and can run on different renewable energy sources.

The Concept of Nano Grids

Nano grids are small-scale decentralized energy systems that include distributed energy sources such as solar panels or wind turbines, as well as storage systems and loads that consume power. They can run alone or as part of a broader grid, providing a robust solution tailored to various energy requirements. This notion encourages communal control over energy sources and use. Unlike microgrids, which power several buildings, nanogrids serve specific sectors or locations.

Key Components and Technologies

As seen in the diagram, the primary components of a conventional nanogrid are energy storage systems (ESS), a nanogrid controller, conventional energy sources, renewable energy sources, loads, and a gateway. In the majority of instances, power can be generated utilizing solar PVs as well as a small wind turbine. Besides that, a battery energy storage system (BESS), hydrogen cells, or a traditional diesel-powered generator are incorporated into the system to provide a consistent supply. Because most of the sources are intermittent, the nanogrid controller plays an important role in controlling sources and loads. Gateways serve as an intermediary link, connecting various electricity institutions, including neighbouring Nanogrids, microgrids, or even the national grid. It may be employed as a bidirectional trader, which increases the reliability of the system. There are essentially two basic architectures of nanogrids: AC nanogrids and DC nanogrids.

Benefits of Nano Grids

The advantages associated with nano grids are numerous. First, they encourage self-reliance on energy by letting users create their own electricity. This minimizes dependency on huge utility corporations, perhaps leading to considerable long-term savings in costs. Second, because nanogrids may run on renewable energy, they assist in reducing atmospheric carbon emissions and battle climate change. Finally, nanogrids may function without the aid of the main grid, ensuring an uninterrupted supply of electricity during disruptions and improving energy security.

Applications of Nano Grids

Nano grids have plenty of possible uses. They can be put in place in business and residential structures, as well as in isolated locations with difficult access via the main grid. Nano grids can be utilized to generate renewable energy for basic household appliances in residential settings. They can offer a reliable power source in commercial settings to guarantee continuous company operations. Nano grids can provide off-grid populations with energy in distant locations, enhancing their standard of living of life and creating new development prospects.

Drawbacks

Although they have significant positive outcomes, nanogrids have several disadvantages. Setup can be complicated by their initial costly nature, particularly in distant places with inadequate infrastructure. In a technical sense, careful planning and balancing are needed to ensure seamless functioning when merging nano grids with large-scale grids. In the energy business, regulatory supervision may also make design and functioning more difficult, particularly for entrants or in areas with stringent energy regulations.

Possible Ways Forward with Nano Grids

How do we overcome these obstacles? It will, however, need a bit of creativity and foresight.

You may be able to lessen the substantial initial expenditure by pursuing government monetary incentives or subsidies. This may reduce the cost for individuals who are eager to work with nano grids. To further share the expense, one option is to investigate alternate finance options like community joint ownership or crowdsourcing techniques.

Collaborating with regional groups, non-governmental organizations, or even global organizations may prove to be quite beneficial in isolated regions. This not only guarantees that the project is in line with local demands, but it may also supply more labour and resources.

Bringing in professionals might be useful in avoiding technological problems. In order to ensure that the integration procedure with bigger grids proceeds as smoothly as possible, qualified engineers and energy specialists may be essential. Further funding for continuous R&D and state-of-the-art technology might aid in resolving any possible technological issues.

Additionally, communication is essential for understanding the regulatory labyrinth. It is essential to interact with regulators, policymakers, and other stakeholders regularly. Gaining a comprehensive understanding of the regulatory landscape, identifying potential obstacles, and perhaps influencing legislation are all benefits. Promoting the usage of nano grids might also be accomplished by advocating, either individually or in concert with others, for more advantageous laws and regulations.

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WHY IS THE EFFICIENCY OF SOLAR CELLS LOW?

Poojani Yataththawala
19 Batch

> **Nano grids, Sparking Energy Independence, Illuminating Sustainable Futures.**

The world is trying to achieve more electricity generation share from renewable energy sources to reduce fossil fuel combustion in electricity generation. The reason behind that is global warming, which is currently the worst challenge to the world. Have you heard about the Madagascar's famine? This severe famine happened between 2021 and 2023 and drew off over 1 million lives due to famine-like conditions. Global warming has led to this unfortunate disaster and many more. When the atmosphere temperature increases, it causes land to dry and reduces water availability, resulting in famine. So, people are responsible for reducing the factors that make the global warming monster healthier. As an action from the energy sector, countries worldwide promise to reduce greenhouse gas emissions from electricity generation. Our country is also a part of that, and according to the latest long-term generation expansion plan, 31% of the energy share of electricity generation was planned to be from solar power. The shocking point is the efficiency of solar panels is low, but the cost is high. In this article, I am trying to explore the factors which have caused the reduction of solar cells' efficiency.

In the Emerging Solar Power Generation article, I have mentioned the external factors that affect the power generation reduction of solar panels. But here, I prefer to talk about the internal factors that affect the lower energy output from a cell; those are simply the losses within a cell. Let us see what they are.

Unfortunately, no sunlight that hits the cell surface is converted into electricity. As shown in the above image, the optical loss, thermalisation loss, and recombination loss can be identified as the main culprits behind these energy losses. When solar photons hit the cell's upper surface, some are reflected, and some get to enter the cell. After that, there are more entries, such as n-layer and p-layer entries. Some photos could not be entered from those entries also because the contact surface has defects, and those make the photon reflect. The n layer and p layer absorb energy from photons. Still, they don't absorb all that comes into them because the n and p materials have band gap energy, which indicates the minimum energy required to excite its electrons. So, if a photon's energy is more than this band gap energy of the layer, that energy will be absorbed by the material. Others are not absorbed because their energy is low, so they go through the material and exit the cell. Because of the above reasons, the cell is missing some photon energy that cannot be absorbed. This missing is called optical loss. Just imagine an electron absorbs a higher energy from highly energetic photons. This electron is not qualified to get into the proper current (electron) flow because it is so unconscious and bothers other electrons, hitting them due to the higher energy. Since other electrons are going properly with the flow, this energetic electron should release its energy as heat and join the flow, as agreed with the majority. This reduction of the energy as heat is called thermalisation loss.

In my previous article, Emerging Solar Power Generation, I discussed what happens inside a layer (p or n) when it absorbs solar energy. Electrons freely come out from the bonds, and holes are generated (here, hole means the loss of the electron). Imagine there are five electrons named a,b,c,d, and e; when they are out of the bond, they generate holes named a,b,c,d, and e, respectively. Suppose these electrons go with the current flow, and electron b sees the hole e. Then, the electron b goes and combines with the hole e. This is called the recombination process. Now, the current flow loses one electron, which means the current is reduced because of this recombination, called the recombination loss.
Those are the main losses happening inside a cell, and we can't eliminate these losses 100%, but we can reduce them a little.

Here is a simple structure of a solar cell. Anti-reflective coating helps to reduce optical loss. It makes the upper surface rough and reduces the surface's reflective quality. Front and back contact are conductive metals, where the generated electrons are collected and taken out as the current. To reduce the recombination loss, buffer layers are applied after the absorber and window layers. The layer applied after the absorber layer is called the back surface field layer.
In conclusion, the reasons for reducing solar cells' efficiency and the challenges in achieving higher efficiency have been discussed. Typically, cell efficiency ranges from 25% to 30% with additional features like anti-reflective coating and buffer layers, while solar panel efficiency hovers around 20%. Ongoing research aims to enhance cell efficiency, suggesting the potential for future improvements in solar panel efficiency.

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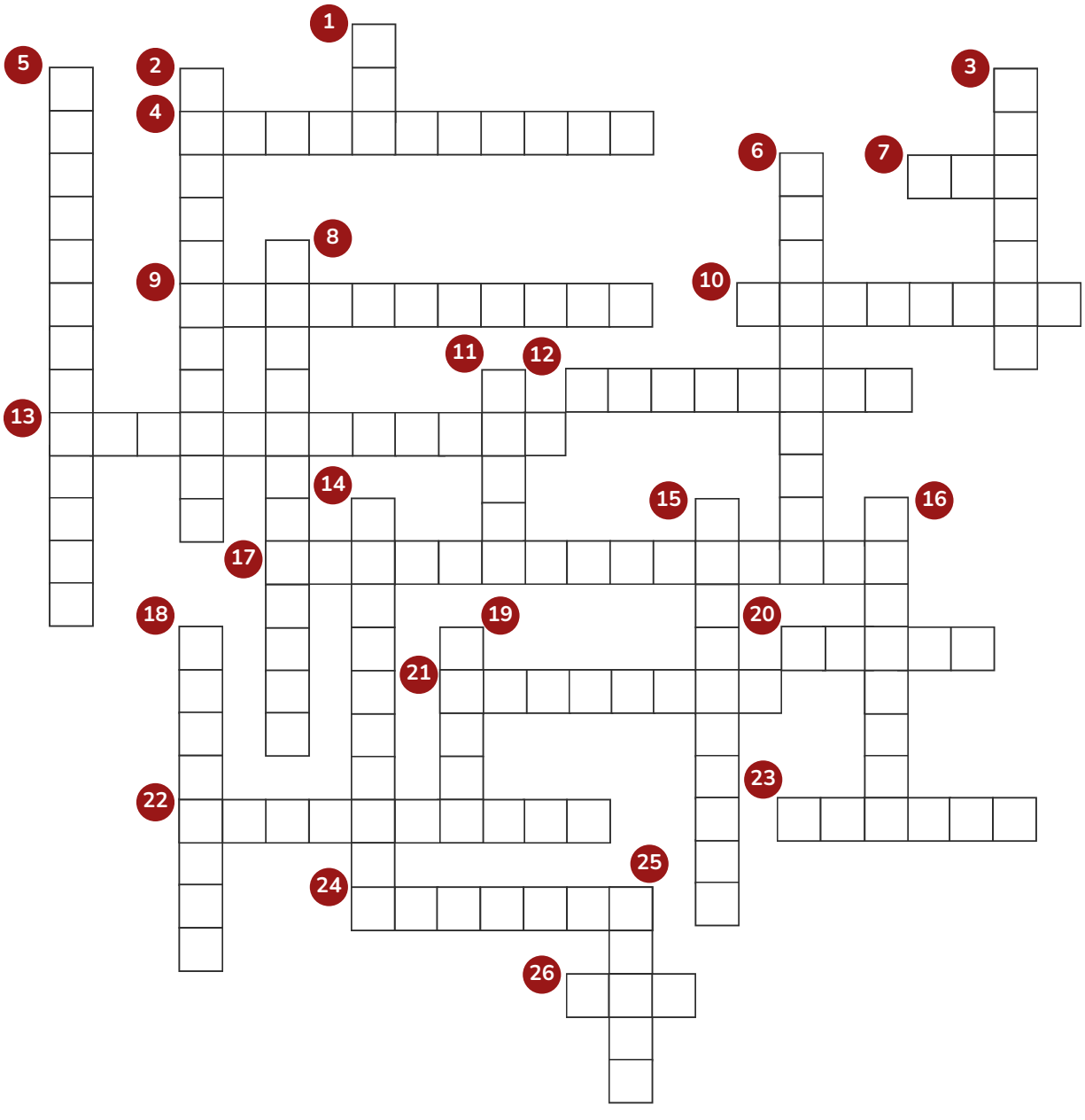
CROSSWORD PUZZLE

SPARK INSIGHTS



Across

4. An electrical circuit which is not completed
7. Sensor used to detect human presence
9. Experimental process of determining the transfer function of a sensor
10. First hydropower plant in Sri Lanka
12. Filter type that rejects low frequencies
13. Used to measure the strength and intensity of a magnetic field
17. The process of matching the parameters of a generator to an electrical grid
20. Colour of wire for ground
21. Device that produces a motion by converting energy
22. A device that measures the intensity of light
23. Circuit that has only one path for electric current
24. SI unit of conductance
26. Unit of reactive power

Down

1. A programming language commonly used in automation
2. The reciprocal of resistance
3. The flow of electrical charge
5. Used to measure acceleration
6. One of the combined cycle power plants in Sri Lanka
8. Device that detects electric charges
11. SI unit of magnetic flux
14. Materials resist the flow of electrons
15. A device that determines revolutions per minute
16. Device that changes direct current (DC) to alternating current (AC)
18. Represent the gain and phase of a system as a frequency function
19. A PCB design software tool
25. Abbreviation for a system that controls processes in industrial settings

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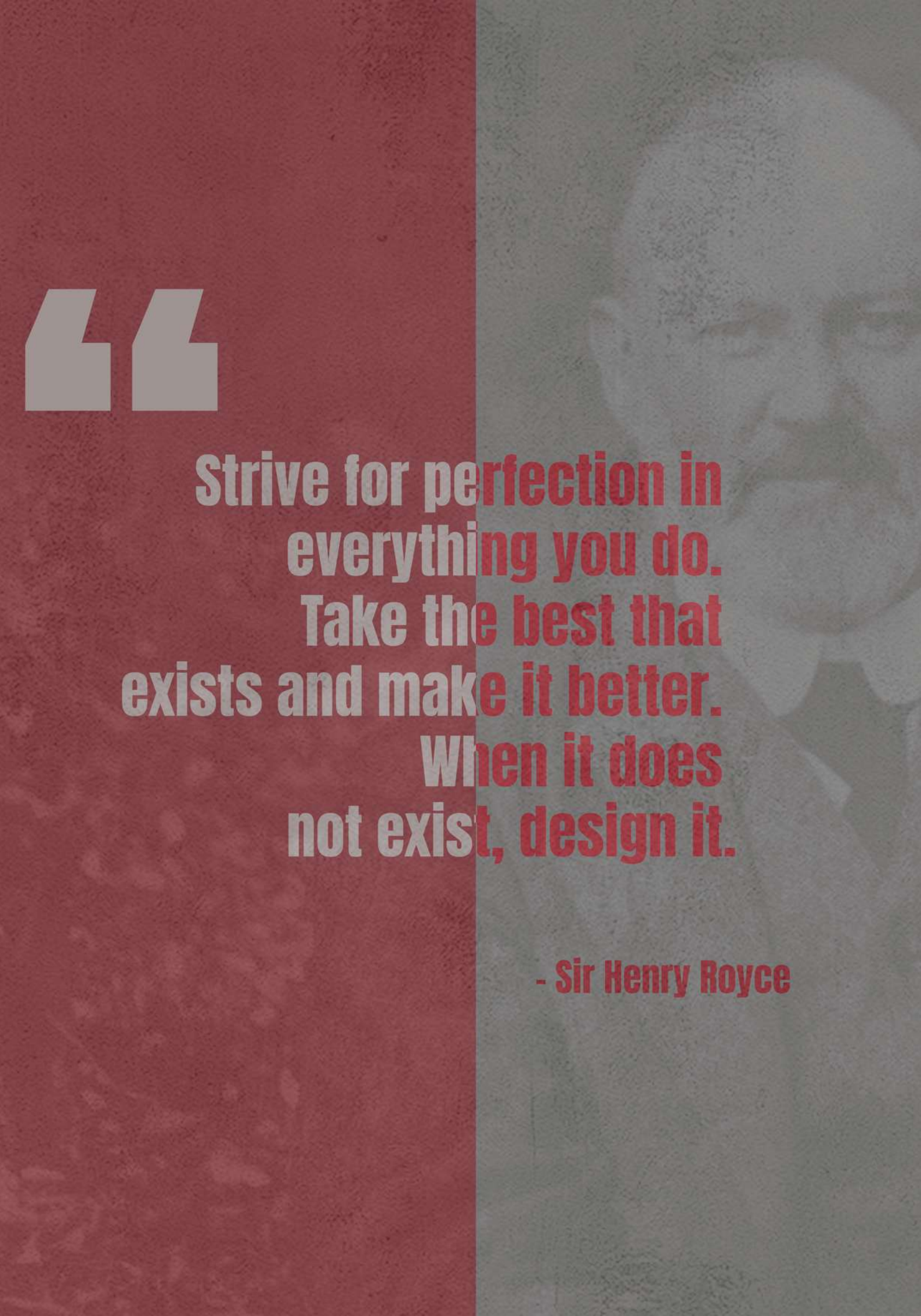
Strive for perfection in
everything you do.
Take the best that
exists and make it better.
When it does
not exist, design it.
- Sir Henry Royce