Annual SDG Report 2021

NUST College of Electrical and Mechanical Engineering, Rawalpindi

1. College of Electrical and Mechanical Engineering (College of E&ME) is one of the oldest and major constituent Colleges of NUST having international standing, with focus on core engineering programs, research, and technology. College of E&ME faculty has actively pursued many local and international funding agencies for further enhancing the capacity in their respective domains and equipping its researchers with most advanced and cutting-edge knowledge suitable for the country's requirements. Among the funded proposals in the preceding year, College of E&ME faculty has taken a lead in R&D of developing advanced solutions in renewable energies including small-scale hydro and solar energy systems. In addition, various proposals are currently under review with different local and international donors such as HEC, PSF, Pak-UK Gateway, and etc.

2. NUST College of Electrical and Mechanical Engineering has four engineering departments which contribute to the following UN suggested Sustainable Development Goals (SDGs):

a. SDG 2: Zero Hunger
b. SDG 3: Good Health and Well-being
c. SDG 4: Quality Education
d. SDG 5: Gender Equality
e. SDG 7: Affordable and Clean Energy
f. SDG 8: Decent Work and Economic Growth
g. SDG 9: Industry, Innovation, and Infrastructure
h. SDG 10: Reduced Inequality
i. SDG 11: Sustainable Cities and Communities
j. SDG 13: Climate Actions
k. SDG 15: Life on Land
l. SDG 17: Partnerships to achieve the Goal

3. A number of events were organized at CEME-NUST in relation to the achievement of SDGs. The details of events are as under:

a. International Conference

1) 4th IEEE International Conference on Robotic and Automation in Industry ICRAI 2021, ***(SDGs: 2,8, and 9)***

a) 4th IEEE International Conference on Robotics and Automation in Industry (ICRAI) was held at NUST College of Electrical & Mechanical Engineering (CEME) on 26th-27th October 2021 by the efforts of NCRA and Department of Mechatronics Engineering. A total of 193 papers were submitted this year out of which 53 papers were accepted and presented during the conference. Professor William Melek from the University of Toronto, Canada, Associate Professor Manoj Karkee from Washington State University USA and Associate Professor Manoj Karkee from Manchester Metropolitan University,UK were the keynote speakers of the conference.

b) The opening ceremony was graced by Executive Director HEC, Dr Shaista Sohail, as chief guest who appreciated the efforts of NUST CEME for arranging the 4th IEEE International Conference on Robotics and Automation in Industry by adding that such conferences not only bring together experts in the relevant fields and pave the way for forging meaningful academic and research collaborations, but also inspire disruptive innovation among students and researchers. She asserted that Robotics & Automation is an exciting and fast-advancing area of research, that enables incorporation of various human capabilities, like intelligence and decision-making, into machines. She urged all participants to fully avail the opportunity through discussing latest trends in Robotics and Automation, and, in so doing, ascertain avenues for joint research in the field.

c) In his welcome remarks, Brig Asim Bashir Waraich, Commandant CEME, highlighted the significance attached to research conferences around the world, which enable knowledge integration leading to development of workable ideas. He said that "NUST CEME is home to novel, state-of-the-art projects, and research of international standards, which, he added, would be reflected in the research presentations during the course of the conference. He maintained that the varsity has been making significant strides forward to reinforce the national economy through creation of scientific knowledge and innovation, which is manifest in its cutting-edge research and initiatives of national significance. He also commended the Department of Mechatronics Engineering and National Centre of Robotics & Automation for befittingly arranging the conference. Dr Umar Shahbaz Khan, the conference chair, informed the audience that 193 research papers had been submitted to the conference and after a thorough review, only 53 were accepted for oral presentation. The conference was attended by three international keynote speakers from Canada, USA and UK. It also included an Industrial Exhibition, Workshop on UR5 Robot and TRIZ.

d) Prof Dr William Melek , Director RoboHUB, University of Waterloo, Canada delivered his keynote on "Safe and reliable human-machine interaction/collaboration robots for industrial settings," addressing the SDG 9 (Industry, Innovation and Infrastructure). Prof Dr Manoj Karkee from Washington State University, USA, delivered his keynote address for SDG 2 (Zero Hunger) and SDG 8 (Decent Work and Economic Growth) on "AI and Robotics in Production Agriculture: Global Perspective and Local Context," and Prof Dr Carl Diver, Manchester Metropolitan University, UK gave his keynote talk for SDG 9 (Industry, Innovation and Infrastructure) on "Industry 4.0, Towards Sustainable Production.". Pictorial view of the conference is shown below. The event is depicted in the picture below:

b. Projects, exhibitions, and competitions

1) 19th All Pakistan University and Colleges Computer Project Exhibition and Competition (COMPPEC) ***(SDGs: 3, 4, 5, 9, and 10)***

a) NUST College of Electrical & Mechanical Engineering (CEME) annually organizes the most prestigious computer and technological event in Pakistan, Computer Projects Exhibition and Competition (COMPPEC). This event provided a platform for students to enhance their exposure by competing with universities all over Pakistan. This year, an overwhelming response with 250+ projects and 400+ participants was received. The event was graced by the presence of Mr. Sardar M. Ilyas as the esteemed Chief guest. The cherry on top was the cultural night which depicted the culture of different provinces through cultural performances by students followed by Cultural Night. Such activities are very important for STEM education and to promote inclusivity among the students. This directly addresses the SDGs like 3, 4, 5, 9, 10.

2) Shell Eco-marathon ***(SDGs: 3, 7, and 11)***

a) Shell Eco Marathon (SEM) competition takes place annually in Americas, Europe and Asia, and is attracting participation of university student teams from all over the world. The competition aims to inspire engineering students to develop new approaches to sustainable mobility and fuel efficiency. Students design and build cars that are to drive around a track with a given amount of fuel, whereby the car with the least fuel consumption (more kilometers per liter) wins. This global competition has stimulated young minds to push beyond the engineering limits of fuel efficiency. In addition, the competition also encourages the team around the world to work for; driver's health and safety, awareness for green living reducing carbon footprints and bring innovation in design & technologies.

b) Team NUSTAG from NUST CEME has been taking an active part in this competition since 2010 and is leading the scoreboard in South Asia by maintaining 1st position since 2018. The team has been also known for their contribution in various awards; safety, innovation, and design etc throughout journey. The comptition being carried out is shown below:

3) Toyota Eco-Youth ***(SDGs: 11 and 13)***

a) A seminar was organized in collaboration with Toyota Indus Motors for discussion on how industries are going Green by optimizing their practices and aiming for zero carbon emissions. Participents of the event can be seen in the images below:


c. Seminars/workshops, and trainings

1) *Seminar on "Ways to Contribute in COVID-19"* ***(SDGs: 3 and 17)***

a) This seminar was conducted on "Ways contribute in COVID-19" under community service-learning course. This seminar aimed to introduce students about problems created by the pandemic in our country and the possible ways of catering those problems during COVID 19 pandemic addressing the SDG 3 (Good Health and Well-Being) and SDG 17 (Partnerships for the Goals).
b) Muhammad Mustafa Raza Khan, president of GKS BMT foundation was the speaker of the seminar. It was a one-day seminar with no registration fee as it was being conducted in the course of community service (CSL).

2) *Seminar on "Empowering Youth to Serve Humanity"* ***(SDGs: 11 and 17)***

a) A seminar on "Empowering Youth to Serve Humanity" was conducted at College of E&ME addressing SDG 11 (Sustainable Cities and Communities) and SDG 17 (Partnerships for the Goals). ALIF Foundation a non-profit organization assisted in the conduct of this seminar. They are the bridge for those who have no idea how to help out the right deserving people. The purpose is "Youth Empowerment." ALIF Foundation strives hard to assist the poverty-stricken and underprivileged class of society by providing financial and moral support. ALIF Foundation renders its honest services for the betterment of society financially but also provide opportunities for the youth by providing a platform for exploring and practicing their skills. Mr. Suhail Chaudhry, founding president of Alif foundation was the speaker of the seminar. It was a one-day seminar with no registration fee as it was being conducted in the course of community service (CSL).

3) *Seminar on "Opening up the Horizons: An Insight into the World of Scholarships, Fellowships & Exchanges abroad"* ***(SDGs: 4 and 17)***

a) A seminar on "Opening up the Horizons: An Insight into the World of Scholarships, Fellowships & Exchanges abroad" was conducted at College of E&ME addressing the SDG 4 (Quality Education) and SDG 17 (Partnerships for the Goals). The seminar focused on guiding our students on how to avail good scholarship opportunities and what skills they require for the said purpose. Dr Waqar Baig is a seasoned academician, a researcher, mentor, speaker, career & education counselor, admin of the famous scholarship network group. He is guiding & mentoring the students since past 12

years. Thousands of Pakistanis studying abroad have been benefitted by his efforts and guidance. This talk was fully fruitful for all sort of students who were struggling for opportunities especially higher studies on scholarships. It was a one-day seminar with no registration fee as it was being conducted in the course of community service.

4) *Road Traffic/ Safety Awareness Campaign* ***(SDGs: 3 and 11)***

a) An awareness campaign was being run by team NUSTAG at various fuel stations for raising awareness about safe driving practices and significance of following road safety instructions. Some glimpses of the campaign are shown below:

*5) Top Gear Series **(SDG: 4)***

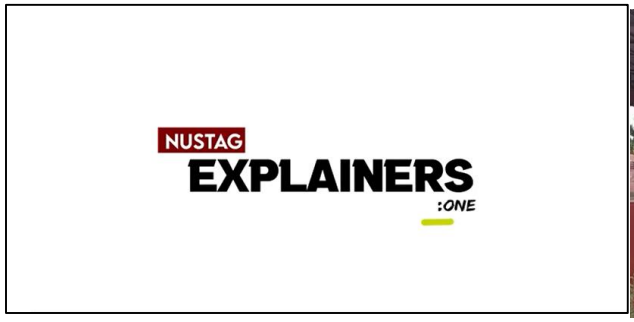
a) NUST believes in the development of young minds and for this, educating them about latest automotive technology, through our experiences and learning, has always been our top priority. In this regard, we have been conducting seminars, visits, and webinars (during Covid-19 situation) so that the learning and transfer of knowledge may not ever stop. Pictorial view of the event is shown below:


*6) Plantation Drives **(SDG: 15)***

a) Keeping in view the current climate change situation and devastating ecosystem, we have always made people aware about importance of trees and green environment. In this regard, NUSTAG took lead and planted trees in university and public parks. Some images of plantation drive are:

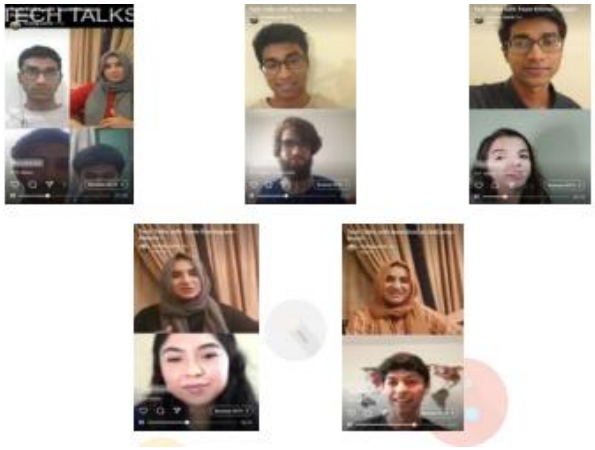
7) *Explainer Series* ***(SDGs: 4 and 15)***

a) During covid-19, team NUSTAG never stopped their mission of raising awareness of climate issues, developing young minds, and educating community on some common technical debates. In this regard, we stared "Explainer Series" that is a series of videos with aim of fulfilling the above-mentioned objectives. Snapshots of the explainer series are given below:



8) Tech Talks ***(SDGs: 5 and 17)***

a) The most exciting and helpful series by NUSTAG was of Tech Talks where we took an initiative of having podcasts with international team, thus inviting teams from all over world. This helped us share each other's knowledge and also to lessen the differences based on religion, nationalities, and race etc.



9) Women Engagement ***(SDG: 5)***

a) Women are encouraged to take an active part in technical and leadership roles by eliminating gender differences and providing them a comfortable environment where they can really grow and develop themselves. The workshop being conducted is depicted below:

10) To promote quality education amongst students, the College held multiple workshops and seminars to contribute to **SDG 04 (Quality Education) and SDG 17 (Partnership for Goals).** Following is the list of multiple seminars and workshops held at the College:

Career Talks in 2021				
Ser.	**Date**	**Company Name**	**Guest Name**	**Designation**
1	06/01/2021	Cambridge University	Mr Zafar Gillani	PHD Scholar from Cambridge University
2	21/01/2021	Solis Energy Pvt Ltd	Saad Ur Rehman	Manager Projects & operations
3	27/01/2021	Nayatel	Mr Taimur Aziz	VP HR
4	28/01/2021	Nokia	Mr Wasiq Nadeem	5G SW Architect
5	30/01/2021	SUPARCO	Mr Abbas Mohyuddin	Manager Marketing
6	30/01/2021	Tetra Pak	Mr Muhammad Hamza Hashmi	Manager Marketing
7	31/01/2021	Mari Petroleum	Mr Areeb Usman	Deputy Manager
8	22/02/2021	ICI Pakistan Limited	Mr Razi Hassan	Supply Chain Manager – Animal Health Business
9	01/03/2021	Honda Atlas Cars	Mr Shabee Ul Haq	Manager R&D

10	08/03/2021	NTDC	Mr Saad Mansoor Rana	AM-operation
11	27/04/2021	Iginite	Umair Qureshi	Manager Monitoring
12	18/11/2021	Millennium Network	Fahad Ali	Manager Marketing
13	07/08/2021	Pakistan Engineering Council	Engr.Javaid Saleem Qureshi	Chairman TEP

d. Research/industrial funded projects

*1) Integrated Renewable Energy Storage Building **(SDG: 7)***

a) The integration of renewable energy sources to the existing power grid is an emerging trend as the world moves towards reducing carbon emissions and minimizing greenhouse effect. Large chunks of land have been allocated for harnessing wind and solar power based on the geographic location and afterwards, these sources are supporting the electrical grid through power supply. A new concept consists of integrating solar, wind and storage to satisfy demand at building level, thus forming active buildings. This research proposes Integrated Renewable Storage Active Buildings (IRSAB) where renewable energy sources such as wind and solar are linked with energy storage elements to satisfy energy needs of active buildings. These buildings are 'active' in the sense that they can extract power from these green sources and interlink with each other to form a network of buildings which can support each other through power exchange. At the same time, these buildings can optimize the usage of energy to minimize losses and maximize user comfort.

*2) Smart Traffic Profiling for Intelligent Road Transportation **(SDG: 11)***

a) This is a joint academia-industry project to develop a working prototype for smart traffic profiling, funded by the Higher Education Commission of Pakistan under the Technology Development Fund Program with project ID # TDF03-219 helped in achieving SDG 11 (Sustainable Cities and Communities). Using state of the art computer vision AI and deep machine learning, the system is able to detect, count and accurately classify multiple moving vehicles on the road from an overhead gantry, and estimate their speed, direction, and dimensions in real-time. The technology has the potential to ensure safe, smooth, and efficient traffic flow on, and ensure the maintenance and sustainability of Pakistan's multi-lane highways, high-speed motorways and strategic routes totaling 12,131 KMs and carrying 80% of the country's commercial vehicular traffic.

*3) Automatic Number Plate Recognition **(SDG: 9)***

a) Smart city initiatives are gaining traction across the globe and aim to use technology to improve the quality and efficiency of urban services. This project is in line with SDG 09 (Industry, Innovation, and Infrastructure), the proposed project is a step in this direction, keeping in view Pakistan's traffic woes on one hand and its security challenges on the other. Specifically, it is intended to study the detection of a vehicle's license plate followed by optical character recognition to read the registration number. Such a system potentially finds applications in traffic surveillance, road rule enforcement, vehicle monitoring at security check posts, toll points or car parks, etc.

*4) Robust Communication Solution for Drone Swarm based Patrolling Operations **(SDG: 9)***

a) Pakistan has a road network covering 263,775 km, a rail network covering 11,881 km, a border length covering more than 5000 km, and CPEC route covering 966 km. Security and surveillance of such gigantic territory are among the biggest challenges faced by different law-enforcement agencies (LEAs), specifically in big cities and strategic routes. Patrolling is the most useful but costly mechanism to meet this challenge, e.g., LEAs in Pakistan spend billions of rupees on patrolling for surveillance and crime control. In line with SDG 09 (Industry, Innovation, and Infrastructure), the aim is to bridge these communication technologies to achieve reliable connectivity among multiple drones and ground control station(s) in almost all geographical areas. In addition, intelligent mobility models will be developed to facilitate drone swarm operations for security/surveillance purposes.

*5) Run-of-River (zero-head) Hydropower Generation Unit **(SDG: 7, 9, 13, and 17)***

a) This project aims at developing a uniquely designed low RPM generator driven by a running waterwheel at zero-head, which is modular, portable, low-cost, convenient to install, and user-friendly. The project is scalable, replicable, and sustainable source of electrical energy. The pilot project will not only help campaign of commercialization of the project in future, but it will also be as a cause to provide electricity to under-privileged people, which are feared to remain un-electrified due to their remote location and access of the national grid. Successful deployment/adoption of the project will certainly lead to poverty alleviation through increased economic activities, and it has great climate impact.

*6) Compensating Variability of Solar Photovoltaic Systems **(SDG: 7, 9, 13, and 17)***

a) In the context of electrical energy, power industry in Pakistan is faced with multifarious challenges including energy deficit, high electricity tariffs, obsolete technology, and environmental impact. These challenges are juxtaposed with untapped potential of renewable energy resources which have been minimally utilized due to technical & economic challenges in the development of renewable energy technologies. The two principal barriers to achieve deep renewable integration are grid operations and the development of associated markets for variable generation. Historically, power systems have been developed in terms of controlling supply to match uncertain demand. At long time scales, this means the construction of more generating power plants and bulk transmission lines. At short time scales, this is reflected on operating the system with an almost inelastic demand, scheduling different types of units able to follow demand along with reserves to handle contingencies. The Pakistani case is a clear example of this trend in terms of expansion in which during the last decade, the installed capacity has been quadruplicated. The status quo in the development of the Pakistani power systems is continuing this trend. However, this idea of relying only on expanding the bulk power system is no longer sustainable. Thus, there is pressing need to develop sustainable models of electrical energy systems using renewable sources, in particular, solar photovoltaic power generation systems.

b) The proposed project is aimed at creating a joint research network with an objective to conduct advanced research on compensating variability of grid integrated solar photovoltaic systems. In this project, we will focus on developing advanced direct load control, monitoring, and optimization strategies to compensate for the increased variability of renewable generation, as well fast and robust fault diagnosis and future power generation forecast. The proposed project will offer cutting-edge research and real-life experimentation. This project will offer a conducive research environment to both researchers and graduate research students to shape their long-term research view and get fundamental and applied methodological tools on the research field.