Issue 4, April 2022

eNSIDER

In This Issue:

Department of Energy Science and Engineering

From the HoD

All the previous ENsider issues came during the pandemic and the team of students did a great job in bringing out these issues in such a difficult time. We have been going on with online classes for last two years and it has been a new experience for all of us. However, things seem to be getting better and hybrid classes have started. We hope that by next semester things will go back to normal. Most of the students are back to the campus and it is likely remaining students will be back on the campus soon.

These two years have been a difficult time for all of us, however, we should hope and strive to take forward the lessons learnt during the time. The paradigm shifts have happened in the teaching and learning practices. Although, we may be going back to the normal times, still there are several good aspects of the online teaching that can be carried forward.

Moreover, as energy engineers and scientists we have seen profound changes in the way we use energy for various aspects of the life. However, the bad the times were, they have given us opportunity to understand the energy economics, energy security and energy usage patterns during the pandemic and thereafter. Let us then hope that these experiences will make us better energy engineers and scientists, as well as, better human beings. Stay safe and healthy.

Professor Suneet Singh

At a Glance: IPCC Sixth Assessment Report

Headlines related to recent extreme weather appear to come out of a science fiction book: even the richest countries in the world can't control widespread fires — they're even burning in the Arctic. Deadly flooding in Germany and Belgium in July 2021 absolutely washed away homes and cars, and greater than 1000 human beings stay missing. Hundreds died in flooding in China. The U.S. Pacific Northwest, recognized for its cool weather, hit over a hundred ranges Fahrenheit for numerous days. And the Arctic misplaced a place of sea ice equal to the scale of Florida in June and July 2021.

These changes are happening with average warming of just 1.1 ˚C (1.98 ˚F) over pre-industrial levels. The newest report from the Intergovernmental Panel on Climate Change (IPCC), the world's most authoritative body on climate science, finds that this is just a taste of what's to come. The article is a glance at 'IPCC Report - Summary for policymakers'

It is unequivocal that human influence has warmed the atmosphere, ocean, and land. Since 2011, well-mixed greenhouse gas concentrations have continued to increase in the atmosphere. The range of total human-caused global surface temperature increase from 1850–1900 to 2010–2019 is 0.8˚C to 1.3˚C, with the best estimate of 1.07˚C. The global mean sea level increased by 0.20 m between 1901 and 2018.

ipcc

INTERGOVERNMENTAL PANEL ON climate change

WMO UNEP

The Intergovernmental Panel on Climate Change is an intergovernmental body of the United Nations responsible for advancing knowledge on human-induced climate change.

The IPCC was created to provide policymakers with regular scientific assessments on climate change, its implications and potential future risks, as well as to put forward adaptation and mitigation options.

Climate zones have shifted poleward in both hemispheres, and the growing season has lengthened by up to two days per decade since the 1950s.

Human influence has been the main driver of the global retreat of glaciers since the 1990s, has warmed the global upper ocean, caused global acidification of the surface open ocean, and led to dropping oxygen levels in many upper ocean regions. From 2011 to 2020, the annual average Arctic sea ice area reached its lowest level since at least 1850. Decreases in global land monsoon precipitation are partly attributed to aerosol emissions, but increases have resulted from rising GHG concentrations and internal variability. Human-caused radiative forcing of 2.72 W per meter squared in 2019 relative to 1750 has warmed the climate system.

At a Glance: IPCC Sixth Assessment Report

A set of five new illustrative emissions scenarios is considered to explore the climate response to greenhouse gas, land use, and air pollutants in the future. Crossing the 2˚C global warming level in the midterm period is likely to occur under the very high GHG emissions scenario and unlikely in the intermediate GHG emissions scenario.

Extreme daily precipitation events are projected to intensify by about 7% for each 1˚C of global warming. Additional warming may amplify permafrost thawing and loss of seasonal snow cover. Precipitation and surface water flows are projected to become more variable within seasons and projected to increase over high latitudes, the equatorial Pacific, and parts of the monsoon regions, but decrease over parts of the subtropics and limited areas in the tropics. Rainfall variability related to the El Niño–Southern Oscillation is projected to be amplified by the second half of the 21st century. Under scenarios with increasing carbon dioxide emissions, the ocean and land carbon sinks may be less effective at slowing the accumulation of carbon dioxide in the atmosphere.

Many changes due to past and future greenhouse gas emissions are irreversible for centuries. Mountains and polar glaciers are committed to continuing melting for decades or centuries and global mean sea level will rise by about 2 to 3 m if warming is limited to 1.5˚C, 2 to 6 m if limited to 2˚C, and 19 to 22 m with 5˚C of warming. It is likely that at least one large explosive volcanic eruption would occur during the 21st century, which would reduce global surface temperature, precipitation and temporarily and partially mask human-caused climate change. Further urbanization together with more frequent hot extremes, will increase the severity of heatwaves. Urbanization also increases mean and heavy precipitation over and/or downwind of cities. In coastal cities, due to sea-level rise and storm surges, flooding will be more probable.

Every 1000 GtCO2 of cumulative carbon dioxide emissions is likely to cause a 0.27˚C to 0.63˚C increase in global surface temperature. Anthropogenic carbon dioxide removal (CDR) can remove carbon dioxide from the atmosphere and durably store it in reservoirs. It aims to compensate for residual emissions to reach net-zero carbon dioxide or net-zero GHG emissions or, if implemented at a scale where anthropogenic removals exceed emissions, to lower surface temperature. CDR methods can have wide-ranging effects on biogeochemical cycles and climate, which can reduce warming, and also influence water availability and quality, biodiversity, lower the atmospheric carbon dioxide concentration and reverse surface ocean acidification.

Emissions reductions in 2020 due to COVID-19 led to temporary but detectable effects on air pollution and a temporary increase in total radiative forcing. Atmospheric carbon dioxide concentrations continued to rise in 2020. Reductions in GHG emissions also lead to air quality improvements. However, these improvements are not sufficient in many polluted regions to achieve air quality guidelines specified by the WHO. If global net negative carbon dioxide emissions were to be achieved and be sustained, the global carbon dioxide-induced surface temperature increase would be gradually reversed but other climate changes would continue in their current direction for decades to millennia.

Sources: https://www.ipcc.ch/about/
https://www.wri.org/insights/ipcc-climate-report
https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM_final.pdf
https://en.wikipedia.org/wiki/Intergovernmental_Panel_on_Climate_Change

Department Bulletin

Professor Rangan Banerjee appointed as the Director of IIT Delhi

Prof Rangan Banerjee has been appointed as Director of IIT Delhi. He took charge on Feb 15, 2022. He has been working as a faculty with our department for the last 30 years. He has done his B.Tech in Mechanical Engineering (1986) and PhD (1991) from IIT Bombay. He joined as an assistant professor in Energy Systems Engineering in 1993, an interdisciplinary program that he would help turn into the Department of Energy Science and Engineering (DESE) in 2007. His areas of interest include energy management, energy systems modelling, energy planning and policy, hydrogen energy and fuel cells.

He has made a significant contribution to the growth of the department. Prof Banerjee has also held notable administrative roles. He was the Associate Dean (R&D) from 2003 to 2006 and Dean (R&D) of IIT Bombay from 2009 to 2012. He has served as the head of DESE for a cumulative of 8 years in the past 15 years.

IIT Bombay Team won X-PRIZE

Team 'SASIITB' has won the X-PRIZE award (of USD 250,000) for carbon removal supported by the Elon Musk Foundation, for 'Demonstration of Carbon Dioxide Removal'. SASIITB is the only single-institution team to win from India, among 23 winning teams from ten countries, out of 195 applicants globally. The announcement was made at the Sustainable Innovation Forum at COP-26 in Glasgow. The team members are Srinath Haran Iyer (PhD student, Climate Studies), Srushti Bhamare (dual degree student, Energy Science), Anwesha Banerjee (PhD student, Chemistry), and Shubham Kumar (junior research fellow, Earth Sciences). The team is mentored by Professor Arnab Dutta (Chemistry) and Professor Vikram Vishal (Earth Sciences). The concept is to develop bioenergy-based carbon capture and sequestration technology and sequester it permanently in the form of salts. This technology will pave the pathway for establishing net-negative carbon emissions.

Editorial Appointment

Professor Suryanarayana Doolla has been appointed as guest editor at IEEE (Institute of Electrical and Electronics Engineers) on the topic of machine learning applications in power electronics. He is also the editor of the IEEE Journal of emerging and special topics in power electronics (2020-present).

Awards

- Professor Suryanarayana Doolla was awarded institute-level S. P. Sukhatme Excellence in Teaching Award in the year 2021
- Professor Santanu Bandyopadhyay was awarded Departmental awards for Excellence in Teaching in the year 2021

Blockchain in Energy Sector

A seminar by Kumael Doongerwala

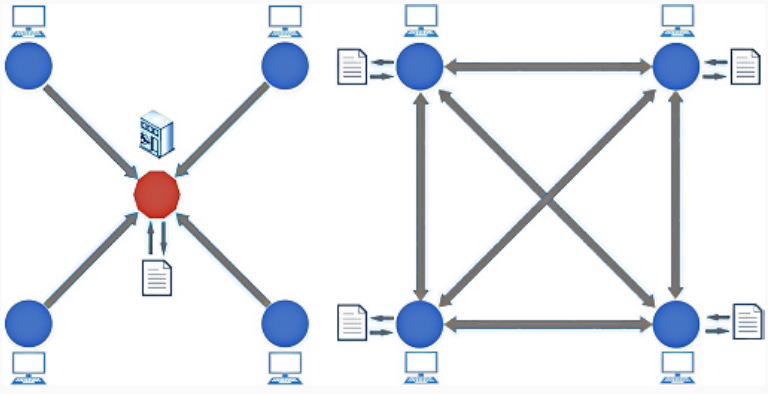
Rising temperatures and the increasing frequency of extreme weather conditions have steadily raised awareness towards the perils of global warming. The governments of countries across the world have responded by setting up ambitious and lofty targets in a bid to tackle climate change. The Prime Minister of India announced India's aim to meet 50% of the energy requirements from renewable energy by 2030. India aims to reduce the carbon intensity of its economy by less than 45 % and aims to achieve the target of Net-Zero by 2070. These targets have pushed for the increased inclusion of renewable energy generation. Renewable Energy Resources (RES), having undergone massive developments in the past decade with improvements in economics and lifetimes, are starting to prove as go-to sources. The increment in the embedded renewable generation requires a massive transition in energy systems.

Renewable Energy Resources (RES) are variable, challenging to predict, and depend on weather conditions, hence needing more flexibility measures to ensure safe and stable operation. Traditionally, power has mainly been generated by large centralized power plants run by non-renewable fossil fuels. This had led the current energy systems to have a rigid structure with a unidirectional flow and minimal customer involvement. These energy systems are not equipped to handle the flexibility and adaptability demanded by the inclusion of a higher share of renewable energy generation. Additionally, with the world moving towards increased customer awareness and involvement, the lack of transparency and customer control is a major drawback of traditional energy systems. A shift from Energy on Demand to Energy as available is required to accommodate the change in the generation. This shift will require the Energy systems to be active, decentralized, complex, and multi-agent with an increasing number of actors and a free-flowing structure. The market structure will shift from being unidirectional to a prosumer-driven structure with multiple parties interacting and trading.

Blockchain technology can play a significant role in ensuring this smooth transition to a multi-agent decentralized energy market. Blockchain at its core is a peer-to-peer distributed ledger that is cryptographically secure, append-only, immutable, and updatable only via consensus algorithms. For a transaction to occur between two parties, say A and B, we need a trusted third-party intermediary which will verify that a transaction has indeed occurred. For example, if A is to pay some 'x' rupees to B, this transaction is often carried out through an intermediary like a bank to allow recording of this transaction. This is true for all traditional transactions, where an intermediary helps bridge the 'trust gap.'

When a transaction occurs between two parties, these transactions, along with the current states of each party (for the case of a cryptocurrency transaction: currency balance), are recorded in a block. Now, let there be one original starting block (genesis block).

A new block with the new set of transactions is added, but it also contains a shortened format from the previous block (a hash value of the previous block). This allows for a chain to be formed, with each new block containing information from the previous block, which is designed so that if the previous block is changed, the new block changes too.



A comparison between centralized and decentralized ledgers

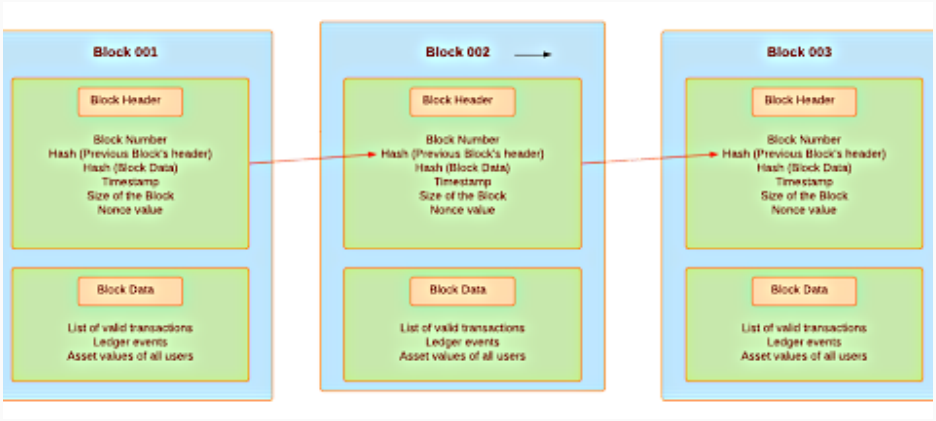
Blockchain in Energy Sector

This allows for the immutability and append-only nature of Blockchain technology. Now since this chain will be present in all users' devices in the network, it becomes a distributed ledger, allowing for a high level of transparency.

Blockchain technology has a multitude of applications in the Energy sector. Blockchain-enabled applications could disrupt the energy and commodities trading market with smart contracts. Smart contracts are computerized transaction protocols that execute the terms of a contract. Smart contracts are, in essence, if-else statements, allowing for the execution of different actions based on different trade scenarios.

A major application of Blockchain technology would be in Peer-to-Peer trading, especially regarding a microgrid model. Since Blockchain functions as a decentralized ledger that can keep track of every transaction occurring within the network, it can allow the trade of energy between prosumers and consumers without routing it via the centralized grid. The current net metering and gross metering model supply surplus energy from a prosumer to the grid and the grid further sends it to the required consumers. However, this results in a loss of efficiency and a lack of transparency.

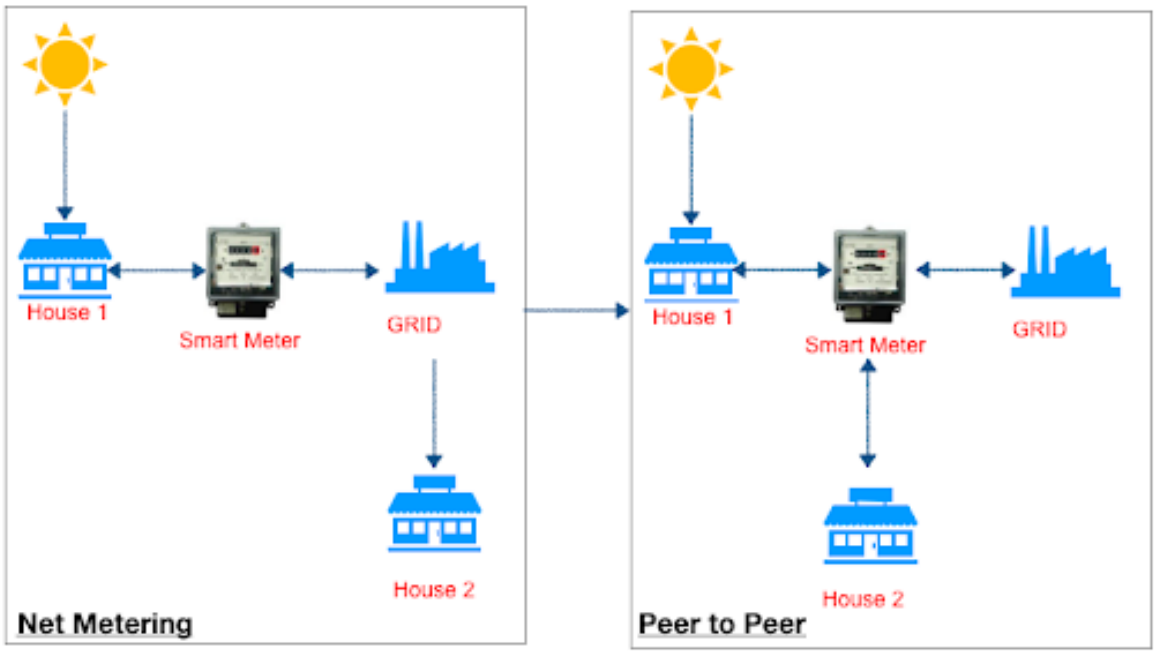
Blockchain technology essentially aims to decentralize systems, and energy markets can provide a great use case for this decentralization. But for this, Blockchain technology needs to be energy efficient at scale and every network user must be fitted with smart meters which can interact with the Blockchain network. This will allow for a shift from energy on demand to energy as available, allowing for more efficient utilization of energy and a highly transparent process.



Representation of chaining of Blocks

Blockchain technology essentially aims to decentralize systems, and energy markets can provide a great use case for this decentralization. But for this, blockchain technology needs to be energy efficient at scale and every network user must be fitted with smart meters which can interact with the Blockchain network. This will allow for a shift from energy on demand to energy as available, allowing for more efficient utilization of energy and a highly transparent process.

Difference between Net Metering and Peer-to-Peer trading



Alumni Profile

Dhruvin Mehta

Please tell us about Yourself.

Hi, I am Dhruvin Mehta from the 2020 Energy Dual Degree batch. I am currently working at the Battery Pack Design department Of Murata Manufacturing Co. Ltd. at their Minato-Mirai office in Yokohama, Japan. I also did my third-year summer internship at the same company. My Dual Degree Project was on the topic of SOC and SOH estimation for EV Battery Management Systems under the guidance of Prof. Pavan Kumar Hari and Prof. Suryanarayana Doolla. I also undertook and completed a Minor in Computer Science and Engineering. Across my 5-year stay at IIT Bombay, I have been a part of the DAMP program, the ITB Placement Cell, British Council English Learning Program, Techfest, and various other project teams. Hobbies include swimming, trekking, reading, and card/online games.

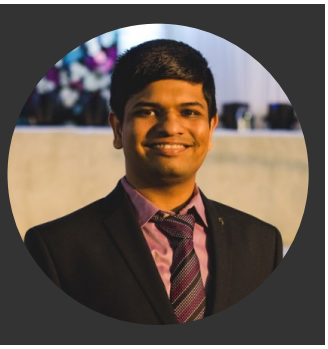
From the second year onwards, we usually get in touch with our department and our professors. How was your experience with the department?

I had specifically chosen this department after researching about it at the time of admission, and I can honestly say that I haven't ever regretted it. Being a small department with plenty of resources, there was by default a lot of interaction with the faculty and staff. As the Internship Coordinator and later the DAMP Coordinator for the department, I also had a lot of interactions with many of our professors on non-academic matters and I wouldn't have been able to get even half of my work done without their help, especially not without the constant support given by our then-HOD Prof. Rangan Banerjee towards the various student bodies. The faculty is there to teach us and is a valuable resource of knowledge and guidance, provided we also put in a genuine effort to learn. During our time too, student opinion was highly influential in restructuring the department curriculum for the new batches.

What are the career opportunities in the energy sector after completing graduation?

There is an energy-oriented aspect in each and every manufacturing or service industry, so I'd say there is a very broad scope for an energy engineer, across the globe. IIT Bombay is already a renowned international institution, and with our ever-growing alumni network, the department has also started gaining serious recognition. Energy consulting is an area that involves a lot of interaction with other industries. For the more core-oriented students, renewable energy projects are underway across the world, and people with a sufficiently solid foundation in electrical, mechanical, and material science aspects of energy generation are in high demand. Battery Storage and Electric Vehicles are two fields that I personally have been keeping a tab on which are going to grow substantially over the next few decades. With the world heading towards an apparent energy crisis, research in energy-related fields is and will be full of opportunities for the foreseeable future. Universities across the world have different energy-related departments and often have collaborations with our professors, whose recommendations can be very favorable during applications. Choosing the right electives and with some additional effort, it is also possible to switch to more traditional engineering fields, which again opens up entirely new worlds of opportunities. There will always be severe competition from the more traditionally known departments such as Mechanical, Electrical, Chemical, etc. and this is where your resume-building and interview skills will come in. Based on personal experience, my advice for students preparing for placement or even internship applications would be to go through internship/placement postings, reach out to alumni, and keep an eye on general energy-related news and who knows, maybe you might find your dream job! At the very least you will be able to rule out what doesn't pique your interests and narrow down your choices. Timing and external circumstances also play a factor, so aim for the best, but always keep backup options open.

> *DESE offers you a rare opportunity where you get to explore different aspects of the real world from inside a safety bubble! So leave the JEE grinding mindset behind and go out and explore!*
>
> DHRUVIN MEHTA



Alumni Profile

You did your summer internship at Murata. Continuing that now, you are working with Murata. What was your motivation to join the company? What all things are you learning from this job?

At the third-year internship stage, I had actually applied to several different companies and even a couple of universities as I was unsure about, well, everything. I hadn't even decided about core or non-core at that point. Murata was scheduled early in the internship season and luckily I passed their test and interview and was offered an internship. My acceptance was mainly motivated by my curiosity regarding batteries and also wanting to travel outside India. I worked on embedded control programming for Energy Storage Systems(ESS) during the ten-week internship. I had a pleasant experience and was able to provide some good results for the company to use further, which contributed to me receiving a Pre-Placement-Offer (PPO) from them during the placement season. However, I also did a lot of research during placements trying to align my technical interests and the available job profiles, and had narrowed it down to 4-5 companies, of which Murata was one. Finally given the existing Placement Policy and my own positive experience, I decided to go forward with Murata. At Murata, I have learned about the practical applications and manufacturing stage issues with different battery chemistries and designs, cost control measures, and designing of the control PCB and external pack. Being in a technical role, I have also had the opportunity to learn some commercially used designing and simulation software.

You are currently living in Japan. Japan is a developed & unique country in terms of people, culture & technology. Can you share some of your experiences with us that differentiate Japan from other countries in the world?

Japan is in many aspects a unique country. It has a well-developed infrastructure, strong technology acceptance, rich cultural heritage, and low crime rates, but it all comes at a high cost of living. It is also an astonishingly beautiful country to travel and explore. Regarding the corporate work culture, I'd like to share some insights based on the experience of several of my peers also working in traditional Japanese tech companies similar to Murata. Traditional Japanese companies highly value loyalty and dedication, giving preference to experience over talent. An employee is expected to be in for the long haul and fit in like a cog in the machine. New employees, especially international hires, are given ample time and support to learn their job. You are not burdened with responsibilities straightaway. The Japanese philosophy of 'Anzen Daiichi' or 'Safety First', combined with strong employee unions, means that the work environment is maintained to high standards, and the physical safety of employees is also prioritized. The philosophy of continuous 'kaizen' or continuous improvement means significant resources are dedicated to perfecting a product over the long term. The language barrier is very real, but if you dedicate some time to studying the language, it considerably speeds up the learning process. Of course, there are two sides to a coin. New employees are rarely given decision-making freedom and each step of promotion/growth is spaced out by several years. Annual salary increments are negligible, but generally, there is significant overtime pay which has led to a prevalent 'expected overtime culture'. Another important aspect of Japanese work culture is the 'honne and tatamae' philosophy, which states that their work and private lives should be completely separated, which also means that colleagues will restrict conversations to work-related matters only. If you want to make friends then you will have to turn to activities outside of work. Of course, these are all traditional Japanese values and in this era of globalization, many Japanese companies have started embracing a more 'western' work culture focused on output and performance indices.

Lastly, what message would you like to give to students?

The Department of Energy Science and Engineering, and in general IIT Bombay, offers you a rare opportunity where you get to explore different aspects of the real world from inside a safety bubble! So leave the JEE grinding mindset behind and go out and explore! Interact with classmates! Forge new friendships! Join a club, start a new sport/activity, take that course you like even if none of your friends are taking it. Talk to seniors, alumni, and faculty on topics beyond the course content. Very importantly, don't hesitate to ask for help when you need it, and offer to help where you can. Of course, a good, stable academic performance will allow you to explore further without stress, so don't neglect your grades. Time is limited, and you won't be able to do everything, so you will also have to make decisions to let go of some things. At such times, to quote a certain wise, old guardian Knight - "You must choose, but choose wisely!". To sum it up, enjoy insti life, within the limits of reason and common sense!

The First: Hydrogen Driven Train

Germany has rolled out the world's first hydrogen driven train called the "Coradia ilint", built by the French TGV maker Alstom.

The company Alstom has been developing a portfolio of zero-emission mobility solutions for several years and has launched an ambitious battery and hydrogen innovation program.

It was at InnoTrans 2016 in Berlin that Alstom presented the Coradia iLint for the first time. The launch of the CO2-emission-free regional train that represents a true alternative to diesel power, positioned Alstom as the first railway manufacturer in the world to develop a passenger train based on hydrogen technology.

Alstom has been working since 2013 on the launch of a regional train equipped with hydrogen fuel cells. The first two 100% H2 iLint trains entered commercial service in 2018 in Germany and, to date, 41 trainsets have been ordered by two German states and successful trials have taken place in Austria, in the Netherlands, in Sweden and now in France.

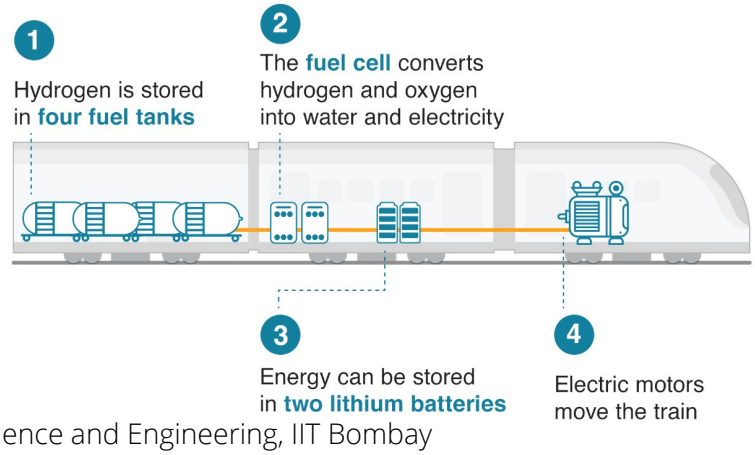
SOURCE:https://www.railway-technology.com/features/next-stop-hydrogen-the-future-of-train-fuels/
https://www.alstom.com/solutions/rolling-stock/coradia-ilinttm-worlds-1st-hydrogen-powered-train
https://youtu.be/6whJ56LmlFI
https://en.wikipedia.org/wiki/Hydrail

The Coradia iLint is the first low-floor passenger train worldwide powered by a hydrogen fuel cell that produces electrical power for traction.

This zero-emission train is silent and only emits steaming condensed water and any excess energy is stored in iron lithium batteries onboard the train. The hydrogen tank feeds a fuel cell that generates energy which is then pushed to an electrical drive train and it also has a small battery that helps maintain power continuity as well as storing energy safe from regenerative braking. These new hydrogen trains can run for about 1000 kilometers on a single tank of hydrogen, similar to the range of diesel trains, and will run 100 kilometers trips at up to 140 kilometers per hour. These trains would be a great addition to any regional area where diesel trains can't be run. They may be expensive to buy but are cheaper to run. Not to mention they are quiet and have zero emissions.

Alstom teams are running and presenting the Coradia iLint to various local stakeholders to highlight the potential of this train in the range of sustainable transport solutions offered in France. It is a part of the national energy transition ambition, which aims to reduce greenhouse gas emissions and noise in transport, a challenge supported by the French government through its Hydrogen Plan, initiated in 2018.

How a zero-emission train works



Know Your Lab:

"Solar Energy Lab"

The motivation behind the solar lab is to deliver a hands-on experience with solar thermal and PV systems to understand their working and assess their performance. The professor in charge of this lab is professor Shreesh Kedare and the lab is handled by professor Anish Modi. The technical staff of DESE maintains the equipment. Students have this solar lab as a part of their third-year spring semester curriculum. This makes students understand different types of solar devices and the device technicalities in-depth. This lab course acts as the basis for research and also many students' dual-degree projects.

The instruments present in this lab are Pyranometer (unshaded and shaded ring), Pyrheliometer, Sunshine recorder, Infrared Radiometer, Ultraviolet Radiometer, Albedometer, Maximum power point tracking (MPPT) and Pulse Width Modulation (PWM) controllers, Buck-boost converter, investors, Flat Plate Collector, Evacuated Tube Collector (natural and forced), Solar cooker, Solar dryer, Solar still and Parabolic trough collector.

Shaded ring pyranometer

Sunshine Recorder

UV Radiometer

Sunshine Measurement

The lab has a facility to measure instantaneous or integrated values of direct, diffused, and global solar radiation incident on a surface and total sunshine hours per day. To measure instantaneous infrared (IR) and ultra-violet (UV) radiations, IR radiometer and UV radiometer respectively are used.

Flat Plate collector

A flat plate collector transforms the incident solar radiant energy into heat. The flat plate collector present in the lab has a tank capacity of 125 litres. This system includes: (a) absorber plate with a tube-fin arrangement, (b) transparent cover, and (c) collector enclosure. solar flat plate collector is preferred for most residential and small commercial hot water applications, due to its simple design, low cost, and easier installation.

Forced circulation evacuated tube collector

Evacuated tube collector solar hot water system

Evacuated tube solar collectors are among the most efficient, reliable, and cost-effective solar collectors. Both forced and natural circulation systems are present in the lab. They can achieve higher temperatures than flat-plate collectors. This is because they employ vacuum insulation which effectively prevents convective heat loss.

Solar PV System

Pulse Width Modulation (PWM) and Maximum Power Point Tracking (MPPT) controllers are present in a stand-alone photovoltaic. The primary task of a charge controller is to steer the power flow from the PV module between the battery and the load and thereby protect the battery from overcharge and deep discharge.

Department Webinars

DESE Industry Core Talks:
Speaker: Mr. Lokesh Jain

Mr Lokesh Jain is alumni of the Department of Energy Science & Engineering, IIT Bombay. He has completed his B.Tech in mechanical engineering from MNIT and his M.Tech in Energy Systems Engineering. Currently, he is the Group General Manager at Tractebel Engineering. He has also worked in renewable technologies, policy advisory, technical consulting and plant design.

A glimpse of the talk

At the start, Mr Lokesh Jain has introduced the firm Tractebel Engineering. It is a part of the global energy and services group. That group includes the world's largest engineering consulting companies. They offer services such as studies and advisory, design and engineering, project management, on-field services in renewables etc.

Career opportunities in solar technology:

- Consulting - feasibility studies, pre-construction studies, design and engineering services
- Equipment selling - solar PV modules, inverters, module mounting system(MMS), robotics, wires and cables.
- O&M Services - module cleaning, electrical maintenance, field testing, performance monitoring.

Renewable Energy: a glimpse of electrochemical storage
Speakers: Professor Anjan Sil

Anjan Sil is a professor at the Department of Metallurgical and Materials Engineering at IIT Roorkee. His areas of interest involve energy storage materials & functional ceramics. Recently, he was awarded DUO-India Professor Fellowship Award.

Professor Amit Bhosale

Amit Bhosale is a professor at the department of hydro & renewable energy of IIT Roorkee. His areas of interest involve proton-exchange membrane(PEM) Fuel Cells, electrolysers, stack development, contact resistance management and cylindrical fuel cells. He has completed his M.tech. from IIT Madras & his PhD from the Department of Energy Science & Engineering, IIT Bombay.

A glimpse of the talk

Initially, Professor Sil introduced different renewable energy technologies and their future. He explained the renewable energy scenario in India. Globally, India stands fourth in renewable energy capacity, fourth is wind power, and fifth in solar capacity. India is well on the way to achieving its targets. Talking about the main topic of the lecture, he started with the importance of electrochemical storage and conversion systems. For more than three decades, intensive efforts have been made to develop lithium-ion batteries, which are now essential to our everyday lives. This success results from the development of carbonaceous materials. One of the biggest challenges in constructing Li-ion batteries is finding new material solutions that will reduce cost, extend lifetime, and improve their performance and safety. Later, the professor touched upon the need for electric vehicles and EV types such as hybrid vehicles, plug-in hybrid vehicles, and fully electric vehicles.

In the second part of the session, Professor Amit Bhosale introduced fuel cell technology and its applications like space and drone, hybrid electric vehicles etc. He explained the concepts of fuel cells and their advantages, such as high-efficiency conversion, quiet operation, unlimited runtime and zero pollution. Cost is one of the main challenges in fuel cell technology. Other than that, thermal management, water management, gas pressure distribution, and leakage are also challenges during the scaling of the fuel cell.

AROUND THE WORLD

UN states that it is not possible to limit global warming without India, G20's contributions

Aug 20, 2021

In India, climate change is no longer a silent killer. Deadlier floods and landslides in various parts of the country have killed hundreds of people. The United Nations climate change report also warns India that climate change will have irreversible consequences.

The importance of NDCs (Nationally Determined Contributions) in meeting the Paris Agreement cannot be overstated. These plans enable the government to plan its national climate responses for the coming years. There is an urgent need for ambitious adaptation, particularly in countries like India, to protect vulnerable populations.

SOURCE: https://energy.economictimes.indiatimes.com/news/renewable/not-possible-to-limit-global-warming-without-india-g20s-contributions-espinosa/85476328

Power finance corporation, GOI issued India's first-ever Euro denominated Green Bond

Sep 17, 2021

Power Finance Corporation Ltd., a financial institution under the ministry of finance, GOI issued its maiden Euro Green Bond of $353 million under that US Global medium-term note program. The bonds will have a tenor of 7 years at a coupon of 1.841%.

"The overwhelming response to the issuance reflects international investors' confidence in PFC. This issuance also demonstrates our commitment to achieve India's renewable energy goals. Further, this bond issuance would help PFC in diversifying its currency book as well as investor base" Mr Dhillon, chairman & MD of PFC said.

SOURCE: https://mercomindia.com/power-finance-euro-denominated-green-bond/

India, UK agree a joint plan on smart power, renewable energy

Oct 8, 2021

Minister for power and new renewable energy Mr Raj Kumar Singh and UK business & energy secretary Kwasi Kwarteng agreed on a new joint programme on smart power & renewable energy. The smart power, renewable energy and storage programme will complement ongoing efforts to promote efficiency power distribution, industrial energy efficiency, electric vehicles, solar & offshore wind generation & energy storage.

In addition to the above plan, they also agreed joint programme will help to create digital solutions for power distribution companies, improving industrial efficiency & boosting electric mobility.

SOURCE: https://economictimes.indiatimes.com/industry/renewables/india-uk-agree-joint-plan-on-smart-power-renewable-energy/articleshow/86874319.cms

UK government and IEA spearhead largest ever global initiative to make products more energy efficient

Nov 4, 2021

The UK government and the International Energy Agency announced that four major economies – Australia, Indonesia, Japan, and Nigeria – have joined their action plan to rapidly improve the energy efficiency of products sold around the world, bringing the total to 14 and making it the largest global initiative of its kind ever.

It focuses on four key products in particular: lighting, refrigerators, air conditioners, and industrial motor systems, which account for more than 40% of global electricity demand and more than 5 billion tonnes of CO2 emissions per year.

SOURCE: https://www.iea.org/news/uk-government-and-iea-spearhead-largest-ever-global-initiative-to-make-products-more-energy-efficient

EVs to cost same as petrol vehicles in 2 years: Nitin Gadkari

Dec 21, 2021

Despite electric vehicles being cost-effective in the long run compared to IC engine vehicles, the initial cost inhibits the vehicle buyers. With more companies aiming to introduce the NextGen vehicles, in the next 2 years cost of EVs will be equivalent to the vehicles that run on fossil fuels, said union minister Nitin Gadkari.

“Not just passenger vehicles, but the government wants to see trucks to run on the battery,” said Gadkari. Adding to that use of biofuel can also be helpful to operate construction equipment to achieve the goal of zero pollution in India.

SOURCE: https://timesofindia.indiatimes.com/city/nagpur/evs-to-cost-same-as-petrol-vehicles-in-2-years-gadkari/articleshow/88398541.cms

India metal mills seek to cut coal use due to ‘bad hit’ of high costs

Jan 24, 2022

After skyrocketing coal prices ate into their profits, India's top metal producers are looking for ways to reduce their consumption of fuel. Benchmark thermal coal prices have more than doubled in the last year and are on track to surpass October's record high as deliveries from Indonesia are delayed and the global energy crisis persists. In the same time period, the price of coking coal, a key raw material in the steelmaking process, has risen by nearly a third in Dalian.

JSW Steel Ltd., India's largest steelmaker by value, missed profit estimates for the previous quarter after expenses increased 77% year on year, owing primarily to higher power and coal prices. Hindustan Zinc is attempting to reduce the cost of coal by improving operational efficiencies and reducing consumption of the fuel by modifying its turbines, CEO Misra said.

SOURCE: https://www.livemint.com/industry/manufacturing/badly-hit-by-high-costs-india-metal-mills-seek-to-cut-coal-use-11643019188641.html

TEAM ZERO WASTE

IIT Bombay (IITB) campus is spread over 550 acres. There are approximately 10,000 students, 7,000 staff, and family members residing inside the campus, while the average floating population of the campus is 3000. Team Zero waste aims to build integrated, sustainable, and scalable waste management solutions, making our institute a Zero waste to landfill campus. Some of the projects they are working on include designing bins for effective segregation, recycling of paper cups, a campus-wide 3-bin effective segregation scheme in collaboration with PHO and hostel council, and composting to manage and reduce the solid waste produced on campus.
Some of the organized events include the following:

IITB Half Marathon

IITB marathon is organized by Citizen India each year on the IIT Bombay campus. Around 4,000 people from within and outside the campus participate in the event. In 2018, around 13,000 PET bottles were used to quench the thirst of the runners at the hydration stations along the course, which were replaced in 2019 with earthen cups by Team Zero Waste. The initiative led to a reduction of 936kg of CO_2 emissions. Moreover, plastic water bottles have an unexpectedly large water footprint. An attempt was made to think through the entire lifecycle of the product used to replace the plastic bottles. To avoid sending the used kulhads to a landfill, these were collected and sent to Prof. Bakul Rao's lab at the Centre for Technology Alternatives for Rural Areas (CTARA), IIT Bombay to be used in a wastewater treatment project.

'Swachata Hi Seva Campaign' by Team Zero Waste and NSS at IIT Bombay

A three-week pilot run for waste segregation was conducted in one of the hostels on campus for 3 weeks with the aim to get some idea to formulate a policy for waste 'segregation at source' for the campus. Door-to-door campaigning was done to make sure maximum people are reached out and regular vigilance was kept on the boxes used for segregation. The segregated waste including plastic carry bags, PET and other plastic, cardboard, paper, aluminium, etc was sent for recycling. The team faced many challenges and learned to overcome those challenges to implement this on a larger scale.

Plastic Recycling Drive at Kendriya Vidyalaya

It was estimated that less than 10% of dry waste from the IITB campus is segregated and recycled. In this recycling drive at KV, the focus was laid on multi-layer wrappers, which are not picked up by our current recyclers. As a part of a week-long challenge, students in the secondary sections were asked to segregate multilayer plastics in PET containers (see picture), make eco-posters, and write essays on plastic recycling. In total students collected around 18 kg of plastics for recycling. Apart, from the quantifiable impact, students also became more aware and observant towards the plastic waste generated in households and ways to reduce as well as recycle them.

Plastic recycling drive Jan'21

We got a great response to the recycling drive in collaboration with Project Mumbai, an NGO that collects these for making furniture. We collected about 60 kgs of plastic including both soft and hard plastic from the whole Institute. It's the first time students have participated with a small donation of 4 Kg of plastics.

Coming Soon...

8th International Conference on Advances in Energy Research

ICAER 2022 provides an excellent platform for exchanging novel ideas and comprehending the challenges pertaining to the energy sector. The conference will be hosting sessions in around 20 tracks, inviting about 15 eminent speakers with expected participation from approximately 600 national and international researchers and industry personnel. The Scientific Advisory Committee for the conference consists of eminent researchers from more than 14 countries.

The topic outlines for the conference are:

- Advanced conventional energy technology: clean coal and carbon capture and storage, oil and natural gas, enhanced oil and gas recovery, IC engines, advances in nuclear energy.
- Renewable and non-conventional energy technology: solar thermal, solar PV, wind energy, ocean thermal/tidal energy, biomass and biofuels, waste-to-energy, polygeneration, multi-vector energy systems, fuel cells, grid integration of renewables, microgrids, smart grids, renewable energy forecasting and scheduling.
- Energy storage: thermal energy storage, electrochemical storage, hydrogen storage.
- Energy policy, economics and management: resources procurement, integration and optimization, energy auditing, energy benchmarking, energy efficiency.
- Electric mobility: electric vehicle policy and regulation, EV integration, EV smart charging, EV infrastructure, power electronic for EVs, Battery management system.
- Energy, environment and society: environmental impacts of energy use, sustainability analysis, energy access, energy poverty.

There is a special track for industry participants who work in energy-related areas at the conference. This track is named 'Industry innovations in energy'. This includes novel methodologies for product design and development, new products, design and analysis of energy systems and equipment from an industry perspective, measures for energy efficiency in manufacturing and service sectors, etc.

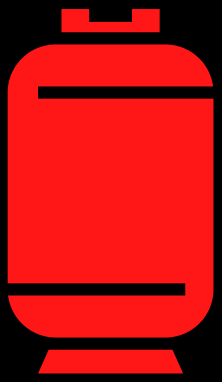
It is our pleasure to invite you to the biennial 8th International Conference on Advances in Energy Research (ICAER). The conference will be held from 7th to 9th July 2022 at IIT Bombay (Virtual Mode).

Only 10% of the energy in a light bulb is used to create light.

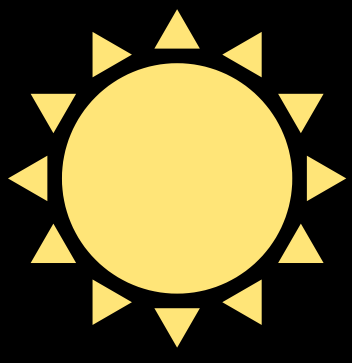
The temperature of single lightning can reach higher than four times the temperature of the sun's surface

JuSt FoR FuN

Liquified natural gas is compressed 600-fold before transportation



The first solar powered satellite is still in orbit



ENsider Team

Front row: (L-R)
Moitreyee Sarkar, Chaitanya Kolhe, Rikin Shah
Back row: (L-R)
Arya Motegaonkar, Tharani Ponnada, Radhika Balasubramaniyam, Srushti Bhamare

We, the team ENsider, are delighted to present the fourth edition of the department newsletter. We have tried to bring to you latest news, engaging articles, enlightening interviews and research stories from our department in this edition. We are thankful to Dhruvin Mehta, Kumael Doongerwala and Misari Bhanani (from Team Zero Waste) for their immense contribution. We would also like to thank our professors and non-teaching staffs for their valuable suggestions. It was an amazing journey for us, and we hope you enjoy going through the newsletter. We welcome your feedback and suggestions on this issue, and we are also open to ideas for the next edition.

- Team ENsider

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