Annual Report – Year 2020

The year 2020 was another productive period of the projects as several important activities were conducted despite of the COVID '19 pandemic crisis.

Clean Energy Expert Panel discussion: Investing in Clean Energy in Sri Lanka – Drivers and Barriers

On 21st of January, Clean Energy expert panel discussion on "Investing in Clean Energy in Sri Lanka – Drivers and Barriers" was arranged in Colomb by the Norwegian Embassy with University of Jaffna and Western Norway University of Applied Sciences (HVL). The panel discussion was focused on various aspects of clean energy transition and power generation in Sri Lanka. The panel consisted of Sturle H. Pedersen, Chairman of Greenstat Hydrogen Asia, a Norwegian clean energy company, Prof. Nalin de Silva, Senior Professor, University of Colombo, Dr. Asanka S. Rodrigo, Director General, Sri Lanka Sustainable Energy Authority, Mr. B. M. U. Senarathna Banda, Deputy General Manager, Renewable Energy Development Division, Ceylon Electricity Board, S. Renganthan, CEO and Managing Director, Commercial Bank of Sri Lanka, and Kamal Dorabawila, Principal Investment Officer, International Finance Corporation (IFC). In addition, Norwegian Ambassador Trine Jøranli Eskedal, Mr. Inge Vikesdal, CEO of Current Solar, Emeritus Professor K. Kandasamy, Competetent Authority, University of Jaffna, Prof. Dhayalan Velauthapillai of the Western Norway University of Applied Sciences (HVL) and Ms. Nanthini Nagarajah, PhD Research Fellow also addressed the gathering. The session was moderated by Professor Rohini M. de Silva, University of Colombo.

Installation of 46.5 kW floating Solar panels

On 24th of January, Sri Lanka's first ever floating solar PV plant was opened by the Norwegian Ambassador to Sri Lanka, Trine Jøranli Eskedal, in Kilinochchi premises of the university (https://www.youtube.com/watch?v=dlElBngkJ3k). Total capacity of the plant is 46.5 kW and it is connected to national grid. The floating solar was designed and developed by Current Solar AS from Norway. This particular design is based on Norwegian marine knowhow from offshore and aquaculture industries and innovatively combines the use of composite beams for mounting the solar panels. Public sector officials, private sector, academics and students were present during the launch.

During the reporting period, the plant has produced **average monthly units of 5,051 generating an average annual income of LKR 840,000**. The daily outputs are recorded online and monitored by both universities in Sri Lanka and Norway. HVL and Current Solar in collaboration with the Institute of Energy Technology (IFE), Norway analyse the output and the reports are presented to Equinor. A Master student from HVL is currently working on optimizing the PV facility of the Kilinochchi plant and is supervised by Prof. Atputharajah, Prof. Dhayalan and Dr. SjujunThe floating Power Plant (FPV) has become a center of attraction in Sri Lanka and research institutions, public and private sector have been in touch with both Current Solar, HVL and UoJ in promoting FPV in Sri Lanka. Daily energy production from FPV is received by HVL and Current Solar online and these data are currently analysed by Institute of Energy Technology (IFE), Norway. Click here to find the media coverage of the event.

'Seminar and Workshop on Clean Energy and Health Application' arranged jointly by HVL and CIT, India

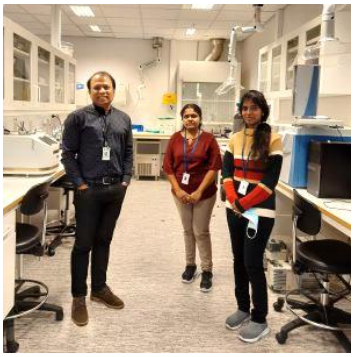
In February 2020, academics (03) and research students (02) from UoJ participated in a 'Seminar and Workshop on Clean Energy and Health Application' arranged jointly by HVL and Coimbatore Institute of Technology, India, held at IIT and CIT, India. Part of the Norwegian minister delegation to India participated the seminar along with the HVL leadership. Although our partners from University of Peradheniya (UoP), NIFS and University of Colombo (UoC) were supposed to participate, due to the fear of Corona, they didn't travel to India. Two MPhil students presented their research finding at the seminar and received a two weeks laboratory training at CIT, India.

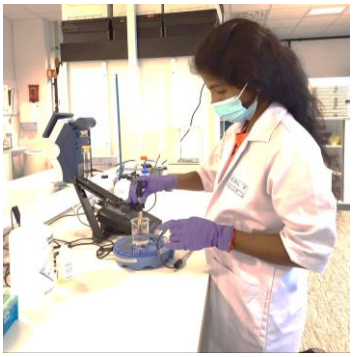
Postgraduate research studentships and forien training under student exchange programmes

The six scholars receiving scholarships under the CBERC project continued their research activities but faced difficulties in carrying out their experimental work due to the temporary closure of the laboratory due to COVID-19 restrictions. The first Master/PhD student under the project Siva Uthayaraj completed his MPhil in July 2020 with the submission of his thesis titled *Enhancement in the Performance of Perovskite Solar Cells by Incorporation of Carbon Nanotubes*. He has continued to work on developing his PhD research proposal during the reporting period.

Mr. Uthayaraj *Ms. Sivagowri* *Mr. Rajaramanan* *Mr. Pirashanthan* *Ms. Kajana S* *Ms. Chapa*

Two MPhil students, Ms. Sivagowri Shanmugaratnam, and Ms. Kajana Thirunavukarasu have gone through two weeks quarantine period in Norway and commenced their research work in November at Western Norway University of Applied Sciences (HVL) under supervision of Prof. Dhayalan Velauthapillai. This is their second visit and will have a research stay for another six months period. Ms. Sivagowri and Ms. Kajana have been working on 'water splitting with metal chalcogenide embedded titanium dioxide materials' and 'Nanocomposites for solar energy storage' and have been undergoing training on different sophisticated equipment related to material characterization and attend seminars and meetings to be arranged by the research group for Advanced Nanomaterials for Clean Energy Applications (ANCEA).





PhD research fellows from Western Norway University of Applied Sciences

This project has incorporated the mobility of both the academic and the students between the two countries. The project has built a long-term academic and scientific collaboration between the two universities through joint supervision and research activities.

(i) Research in Jafna on in-depth analysis of energy policies in Sri Lanka

Ms. Nanthini

The PhD research fellow, Ms. Nanthini from HVL carried out her data collection in Sri Lanka in January and February 2020 and returned to Norway in early March. She has been working on fulfilling PhD registration process with the university and has written an article titled *Understanding the sustainability transition pathway and the role of FDI in transition: The case of Sri Lankan power sector.* She completed three mandatory PhD courses for 15 ECTS. The courses were conducted digitally due to COVID-19. She also commenced conducting phase-II of her interviews with Norwegian stakeholders. The interviews were carried out digitally.

Research activities and joint supervision at HVL/UoJ for both Master/PhD students from Sri Lanka though hindered by the pandemic, gave new avenues through the virtual platform for academics and students from Norway, Sri Lanka and India to have weekly webinars leading to the establishment of new research groups with mentoring and guidance from different scholars in the participating countries.

(ii) Establishment of a new Research Group on Simulation Studies on PV and Health Applications

Mr. Håkon

A new research group on a computational study on nanomaterials for PV and Health applications was established in 2020 and a new MPhil student, **Ms. Chapa** was recruited under the project. **Dr. A. Thevakaran** has been serving as a principle supervisor of the student. This is the first such research group in Sri Lanka. The PhD research fellow Håkon Eidsvåg from HVL, during his research stay in Sri Lanka has been providing his support in establishing this group in early 2020. The project envisions, the expansion of this group through national collaborations with similar competent institutions benefitting Sri Lanka in the long run. It is now planned to establish simul ation of nanomaterials activites at UoP and UoC in 2022.

Moreover, interest has been shown to establish a new research group at UoJ using nanomaterials for health applications to work in partnership with HVL and UiB. The academic expertise in this particular field exists at UoJ and **Dr. T. Pathmathas** will lead the group at the university of Jaffna. The recruitment process of a MPhil student commenced during the reporting period. Further, during the reporting period, the recruitment of two more master students on these new activities was in progress. Research fellow Håkon Eidsvåg was sopposed to have a 6 month researh stay at UoJ, but unfortunately due to corona situation he has to abrupt his stay in SL and had to return to Norway in mid March 20 after a 2 month stay.

Science Education for Bright Future

As part of the outreach activity and to strengthen and attract more students to the STEMM field, the Faculty of Science, University of Jaffna organized the event 'Science Education for Bright Future' from 4 - 7 March 2020. The event was partially funded by the CBERC project. It focused on the practical aspects of the Sri Lankan Science curriculum from grade 6 to 11 through exhibition, experimentation, discussions and explanations in fields of Biology, Zoology, Chemistry, Physics and Computer Science. Nearly 30,000 students from different schools in the Northern Province participated. The members of the clean energy research group actively engaged and contributed towards the success of this exhibition by displaying various clean energy demonstration k its.



Webinar "Early production results from Sri Lanka's first floating PV plant"

Weekly webinars related to clean energy technologies have been organized by the group.

- On an invitation extended by the International Electrical and Electronic Engineering (IEEE), Sri Lankan Chapter, Torgeir Ulseth of REC Solar/Current Solar who led the engineering part of the pilot project at the UoJ, delivered a talk on "Early production results from Sri Lanka's first floating PV plant" on 08 May 2020.
- Prof. Dhayalan Velauthapillai delivered a talk on "Higher Education and Research Collaboration on Clean Energy Technologies" at the webinar series organized by the Northern Province, Sri Lanka.
- Dr. Buvanenthiran from the University of Tromsø together with expatriates from the USA had webinars with Sri Lankan private sector companies to identify opportunities for research and industrial collaborations and graphene was identified as a possible way forward for a new collaboration.

Training workshop on 'AFM and XRD : Effective research tools for material research'

Clean Energy Research Laboratory, Department of Physics received an atomic force microscope (AFM) and an x-ray diffractometer (XRD), worth of 12 million rupees each, from the State Ministry of Skills Development, Vocational Education, Research & Innovations, and Royal Norwegian Embassy in Sri Lanka, respectively. On the request made by our collaborators from National Institute of Fundamental Studies and Universities of Peradeniya, Ruhuna and Kelaniya, a Training workshop on "Atomic Force Microscope (AFM) and X-Ray Diffractometer (XRD) as effective research tools" is scheduled to be held at the Clean Energy Research Laboratory, Department of Physics for training the research students on September 12 & 13, 2020 (weekend). Dr. U. Sutharsini and Dr. M. Thanihaichelvan served as resource persons of this training workshop.



Inaugaration of the first Master degree programme in Clean Energy Technologies

The vice-chancellor and Ambassador Her Excellency Trine Jøranli Eskedal, the Ambassador of Norwegian Embassy in Colombo inaugurated 'Master of Clean Energy Technologies' Programme in collaboration with Western Norway University of Applied Sciences on 19.09.2020.



Curriculum of this Master degree programme was approved by the UGC and was the first of its kind in Sri Lanka. Sixteen students (15 from Sri Lanka and 1 from Norway) enrolled for the degree programme. Lectures have been conducting through zoom during the weekends by lecturers from the University of Jaffna, University of Peradeniya, Western Norway University of Applied Sciences, Coimbatore Institute of Technology, PSG College of Technology (India) and Chalmers University, Sweden. Dr.M.K.Ahilan and Dr.T.Pathmathas have been serving as joint coordinators of the programmes since September 2020.

Research Publications

Research students under the projects published more than 15 articles or abstracts in which five articles are published in SCI Exapanded journals in the year 2020 (http://project.jfn.ac.lk/hrncet/index.php/publications/), and one special issue related to AMCEHA 19 (http://conf.jfn.ac.lk/amceha/) was published in Elsevier journal. This was the first of this kind published at UoJ.

1. Kajana T, Velauthapillai D, Shivatharsiny Y, Ravirajan P, Yuvapragasam A, Senthilnanthanan M. Structural and photoelectrochemical characterization of hetero-structured carbon sheet /Ag_2MoO_4-SnS/Pt photocapacitor. J Photochem Photobiol A Chem, 2020; 401, 112784, DOI: 10.1016/j.jphotochem.2020.112784. SCI expanded, Impact Factor: 3.306 (2020); SJR Rank : 0.714
2. Siva U, Murugathas T, Yohi S, Natarajan M, Velauthapillai D, Ravirajan P., Single walled carbon nanotube incorporated Titanium dioxide and Poly(3-hexylthiophene) as electron and hole transport materials for perovskite solar cells. Mater Lett, 2020, 276, 128174. DOI: 10.1016/j.matlet.2020.128174, SCI expanded, Impact Factor: 3.204, SJR Rank : 0.755.
3. A.Pirashanthan, M.Thanihaichelvan, K.Mariappan, P.Ravirajan, D.Velauthapillai, S.Yohi ; A multifunctional ruthenium based dye for hybrid nanocrystalline titanium dioxide/poly (3-hexylthiophene) solar cells; Materials Letters, 2020, 274, 127997, SCI expanded, Impact Factor: 3.204, SJR Rank : 0.755.
4. Pitchaiya S, Eswaramoorthy N, Natarajan M, Santhanam A, Asokan V, Madurai Ramakrishnan V, Ravirajan P, Velauthapillai D. Perovskite Solar Cells: A Porous Graphitic Carbon based Hole Transporter/Counter Electrode Material Extracted from an Invasive Plant Species Eichhornia Crassipes, Scientific reports 2020, 10(1), 1–16, SCI expanded, Impact Factor: 4.13; SJR Rank : 1.414.
5. Rajaramanan T, Natarajan M, Ravirajan P, Senthilnanthanan M, Velauthapillai D. Ruthenium (Ru) Doped Titanium Dioxide (P25) electrode for dye sensitized solar cells. Energies. 2020, 13(7), 1–13. SCI expanded, Impact Factor: 2.67, SJR Rank : 0.612.

Conference proceeding in MaterialsToday: Proceeding – Elsevier Ltd.

6. Peer-review of abstracts was performed under the responsibility of the scientific committee of the AMCEHA (http://conf.jfn.ac.lk/amceha/) and the proceedings of selected full papers were edited by Smagul Karazhanov, Vishnukanthan Venkatachalapathy, Meena Senthilnanthanan, Volume 23, Part 1, Pages1-138 (2020) https://www.sciencedirect.com/journal/materials-today-proceedings/vol/23/part/P1.

Sgd.
Prof.P.Ravirajan, Coordinator/CBERC Project-UoJ

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Prof. Dhayalan Velauthapillai, Coordinator/CBERC Project-HVL