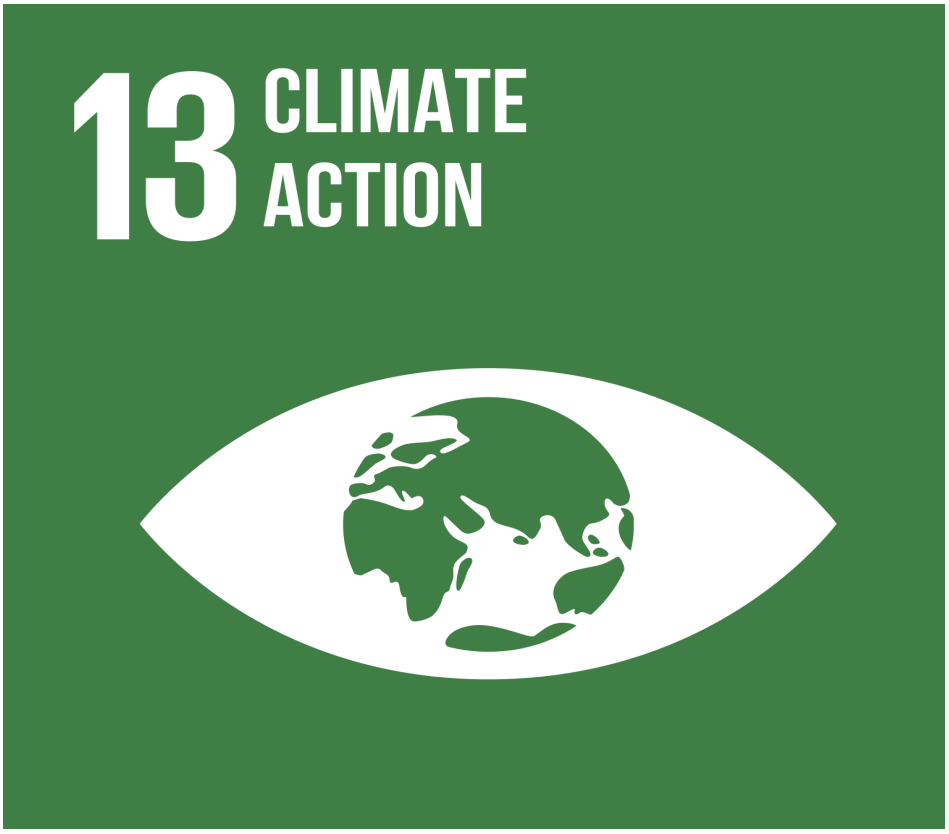
2022



SDG-13: Take urgent action to combat climate change and its impacts

CENTRE OF EXCELLENCE IN ENERGY SCIENCE AND TECHNOLOGY

Shoolini University

Shoolini University, Bahjol, Solan, Himachal Pradesh-173229
www.shooliniuniversity.com

Executive Summary

Shoolini University has prepared a well-researched National Document on the Implementation of United Nations Sustainable Development Goals (UNSDGs) in Higher Education Institutions in collaboration with Association of Indian Universities (AIU). Under this initiative a number of steps in awareness, education, research and transfer of technology have been taken to combat climate change and its impact by 2025. The use of renewable energy sources, reduction in the use of fossil fuels in transportation, community cooking, building design and construction have been taken. As per THE Global Impact Rankings announced in 2022 Shoolini University has bagged top No.43 global ranking for SDG 7 and No.41 in SDG 6 which are related to SDG-13. This report presents the status of implementation of UNSDG-13 and governing policy at Shoolini University, Solan, Himachal Pradesh, India during 2022-23.

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1. Introduction

As per the UN SDG-13 the main task is to take urgent action to combat Climate change and its impacts. The climate change has resulted in warmest decade, forest fires, droughts, floods, changed weather patterns, droughts, floods, changing sea levels and a number of other climate disasters affecting agriculture, food security, economy and lives of people all over the world. Thus, there is need for higher education institutions (HEIs) to combat the climate change by creating awareness, imparting education, action oriented research and policy initiatives. In this context, the Shoolini University has taken a number of steps to combat climate change and its impact by a number of measures like utilising renewable energy sources, reduction in the use of fossil fuels in transportation, community cooking, agriculture practices in developing appropriate drought resistant plant varieties.

This report presents the status of implementation of United Nations Sustainable Development Goal (SDG)-13 and governing policy at Shoolini University, Solan, Himachal Pradesh, India for the year 2022-23.

1.1 Education

The global thrust for climate change mitigation calls for all organizations and higher education institutions to take immediate measures to lower their carbon footprint. Shoolini University has established a Centre of Excellence in Energy Science & Technology (CEEST) in 2019 which

is led by Prof. Shyam Singh Chandel who comes under the global top 2% scientists according to research conducted by Stanford University.
(Stanford Research Link: https://elsevier.digitalcommonsdata.com/datasets/btchxktzyw)

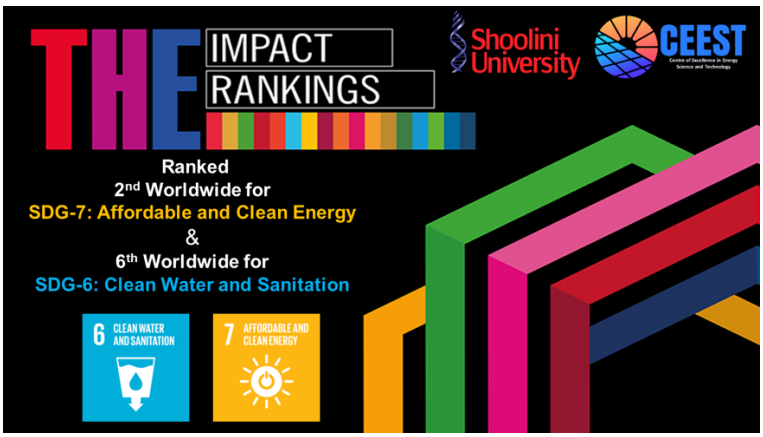
The Centre is spearheading the action on various UN SDGs in the University. It has introduced education at B.Tech (Renewable Energy Technology), Master in Energy Technology, Master in Climate Science and Sustainable Development and PhD in Energy, Renewable Energy and Climate Change Issues and Sustainable development. **CEEST was ranked 3rd in India for Environmental Science and 15th in India for Energy Research by SCIMAGO Institutes Rankings 2022**.

CEEST Website link: https://shooliniuniversity.com/center-of-excellence-in-energy-science-and-technology.

SCIMAGO Ranking Link:
Rank-3:
https://www.scimagoir.com/rankings.php?sector=Higher+educ.&area=2300&ranking=Overall&country=IND
Rank-15:
https://www.scimagoir.com/rankings.php?sector=Higher+educ.&area=2100&ranking=Overall&country=IND

1.2 Research in Energy and Climate Action

A large number of research papers in these areas have been published in top ranking Journals which has led to rank 2 for SDG 7 & No.6 in SDG 6 for the University as per THE global impact ranking in 2022 and rank 43 and 41 respectively in 2023.



Evidence:

SDG-7 Rank (2023):

https://www.timeshighereducation.com/rankings/impact/2023/affordable-and-clean-energy?page=1

SDG-6 Rank (2023): https://www.timeshighereducation.com/rankings/impact/2023/clean-water-and-sanitation?page=1

Research in Energy, FWCI metrics related to SDG-7 and 13 of Shoolini University:

Highlighted research of Centre of Excellence in Energy Science and Technology in 2023

Article in PV Magazine: CEEST is researching on alternative refrigeration technologies that have the potential to reduce GHG-based conventional air-conditioning systems hence contributing to SDG-13 fulfillment:
https://www.pv-magazine.com/2022/11/04/pv-powered-thermoelectric-cooling-for-air-conditioning-in-buildings/

CEEST has catalyzed the action on sustainable Development goals in the University by preparing a National Document titled as "**Building a Sustainable Future - How Universities Can Help Implement SDG Goals"** on the Implementation of UN SDGs in Higher Education Institutions in India in collaboration with Association of Indian Universities (AIU) during 2021 which has been published in March, 2023 and launched by the **former President of India** Mr. Ramnath Kovind.

Evidence: https://shooliniuniversity.com/news/former-president-kovind-releases-shoolini-aiu-joint-publication

Already a governing 'Energy and Environment Policy' has been formulated in 2019 to set the roadmap and required actions to make the University carbon neutral by 2025.
In addition to the latter, the CEEST has also prepared two new policies namely the sustainable procurement and sustainable investment policies of the university to further align the university towards the SDGs. The scientists are working in priority research areas on Climate change in Energy, especially use of renewable energy applications in Agriculture, Sciences, Engineering, Biotechnology, Food technology and Pharmacy. The main objective of these initiatives is to develop the University as a sustainable education and research hub and township to be model for the higher education Institutions in India.

2 Combating Climate Change

According to UN, the global CO_2 emissions have risen by 6% in 2021, the highest ever recorded value. Climate funding fell short by USD 100 billion, indicating that not enough action is being taken in-spite-of commitment towards the same. It is estimated that over 700 million people will be displaced by 2030 due to droughts and sea levels are expected to rise 30-60 cm by 2100. The United Nations Sustainable Development Goal - 13 aims to combat climate change and urges a global effort to take urgent action to lower the environmental impact and switch to sustainable technologies and practices.

Shoolini University has been one of the early movers in adoption and implementation of SDGs in campus and had created the Energy and Environment policy in 2019 and set targets to be fully carbon neutral by 2025 through various measures like use of photovoltaic power, biogas, sustainable building materials, use of passive solar architecture, waste recycling, waste water recycling and purification, waste to energy, tree plantation in the campus, protecting adjoining Cir Pine forest from forest fires thus protecting the environment. Several measures have already been undertaken by the university which are highlighted in this report.

3 Towards Carbon Neutral Sustainable Campus through Mandatory Energy and Environment Policies

The Energy and Environment Policies align Shoolini University to achieve carbon neutral sustainable Campus by 2025 and main highlights of the policy are as follows:

Action plan:

- Installation of solar PV on grid and standalone power generation system in the university premises.
- Installation of solar water heating systems in the university premises.
- Installation of Concentrated Solar Technology based community Steam Cooking Systems for Hostels to save conventional fuels and building integrated cooking system.
- Installation of Solar Street lights for saving conventional electricity in the university campus.
- Installation of Bio-gas plants to generate power from the bio-residues like kitchen waste, cow dung or other wastes generated in the campus premises. Focus will be given to implementation of Biomass Gasification, Pyrolysis in the campus.
- Installation all energy efficient electrical or electronic devices/equipment/masonries in other to save energy in the campus.

- Measures to reduce vehicular pollution in the Campus. Restriction of heavy vehicles inside the campus during day time. For night movement of heavy vehicles necessary permission required from the competent authority.
- Promotion of shared Cab/Taxi and personal cars during office hours. Encourages faculty and students to use public transport.
- Promotion of electric vehicles/Carts in the university campus or not allowed to buy 1200 CC above cars for official uses.
- Initiation of regular annual tree plantation during ***Van Mahotsav*** (Forest Festival) in the campus and surrounding areas for CO_2 emission reduction.
- Installation of bamboo based and regular waste collection dustbins instead of plastic dustbins in the university campus. This generates income to local bamboo basket makers artisans also
- Implementation of waste recycling and waste treatment plant in the campus .

(For details on Energy policy, Environment policy refer to attached pdf)

4 Sustainable Procurement Policy and Sustainable Investment Policy

The Sustainable Procurement Policy supports the need to procure goods and services for the university ensuring compliance with applicable regulations, requirements which the university must satisfy, and appropriate business processes in relation to sustainable practices and sustainable goods, materials. intends to meet the procurement requirements and applies to all SU employees and any personnel responsible for the acquisition of goods and services for the university. The policy mandates all procurement decisions are to be carried out in consideration to use of environment friendly, energy efficient technology and goods. The Sustainable Investment Policy highlights the investment decisions of the university to be guided by sustainability principles and university shall be open to investment in green projects, bonds and sustainable infrastructure. With regards to climate change, the university relies on information and commitments supported by public initiatives such as Science-Based Targets and Climate Action 100+ Benchmark.

(For details on Sustainable Procurement Policy and Sustainable Investment Policy refer to attached pdf)

5 Disaster Management Policy

The university has an official Disaster Management Policy which is publicly available and directs all concerned activities of the university to take into account sustainable practices, energy efficiency and climate change mitigation. ***(Copy of the Disaster Management Policy is enclosed).*** The university has been conducting awareness activities on disaster management since 2019. The university also has a dedicated Centre for disaster management research.

Related links are as follows:

https://www.facebook.com/people/Disaster-Management-and-Climate-Change-Shoolini-University/100066612164487/?ref=page_internal&mt_nav=0

https://shooliniuniversity.com/research-centre-in-disaster-management

6 Lowering GHG Emissions by Solar Energy Production and Consumption

Under its Energy policy, Shoolini university has installed a 400 kWp rooftop photovoltaic power plant in the campus to partially meet its energy requirements. As an follow up , all the new buildings are planned to be constructed as energy efficient and solar PV grid integrated plants are planned. The electrical energy used by the university was 6,422 GJ and that generated by solar PV plant was 1476.4 GJ offsetting about 3,34,237 kgs of CO_2 in 2022. The overall emissions and energy production is given is given in following table.

Table 1: Energy and Emissions Summary

Year	Net Energy Consumption (kWh)	Net Energy Consumption (GJ)	Solar PV Generation (kWh)	Solar Fraction (%)	Total CO_2 Offset (kg)	Total CO_2 Emissions (kg)	Total CO_2 Emissions After Offset (kg)
2022	17,84,027	6,422	4,10,107	23%	3,34,237	14,53,982	11,19,745

Total Scope-1 Emissions (2022)	60,309	kg CO2e
Total Scope-2 Emissions (2022)	11,19,745	kg CO2e
Total Scope-1 and Scope-2 (2022)	11,80,054	kg CO2e

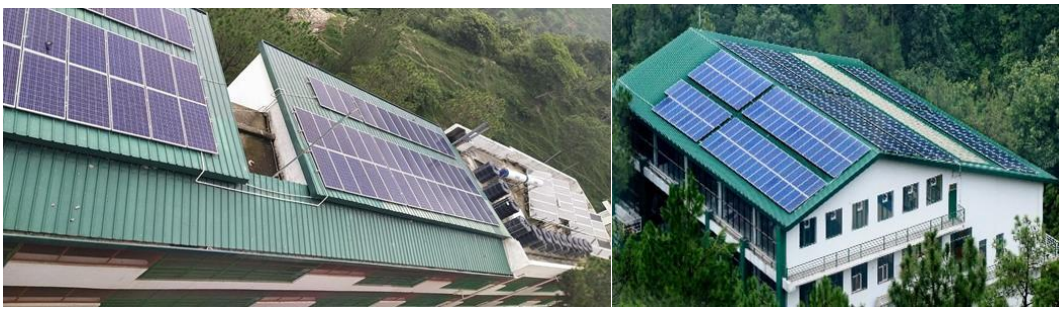


Figure 1: 400 kWp PV power plant installed in the university

7 Designing and constructing Low carbon footprint buildings-use of environment friendly building materials

Under the mandatory Net Zero Energy and Passive Solar housing Policy, the university has developed a Yogananda Ville with a number of solar huts in the campus using sustainable building materials like wood, bamboo, slate, stone, mud, stabilized mud blocks etc. shown in figure-3 to 9.

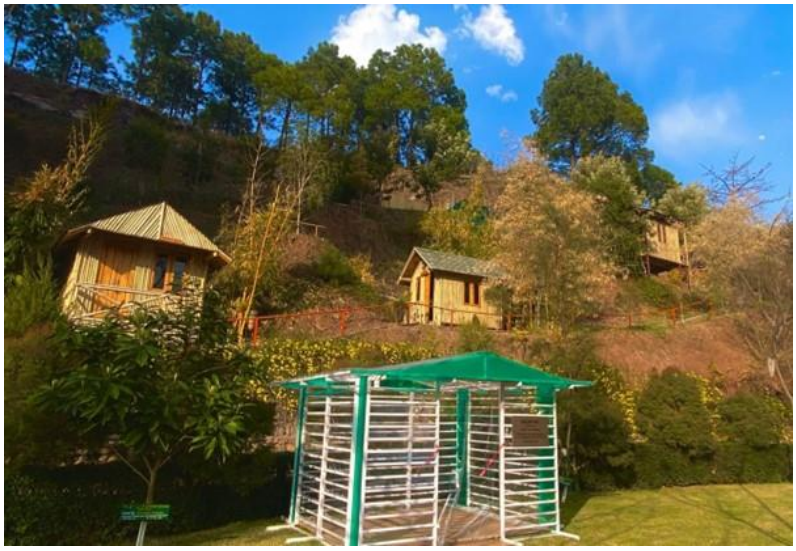


Figure 2: Wooden huts /houses in Yogananda Ville at Shoolini University.

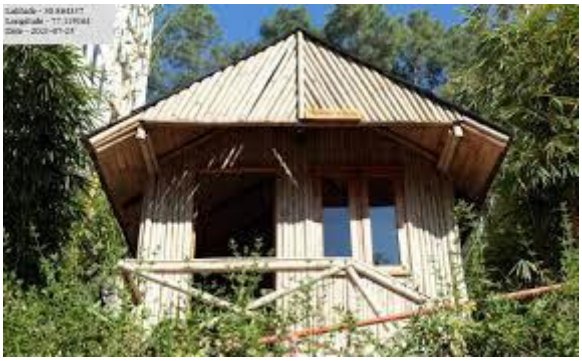


Figure 3: Bamboo and slate-roof huts for online lectures constructed during Covid times

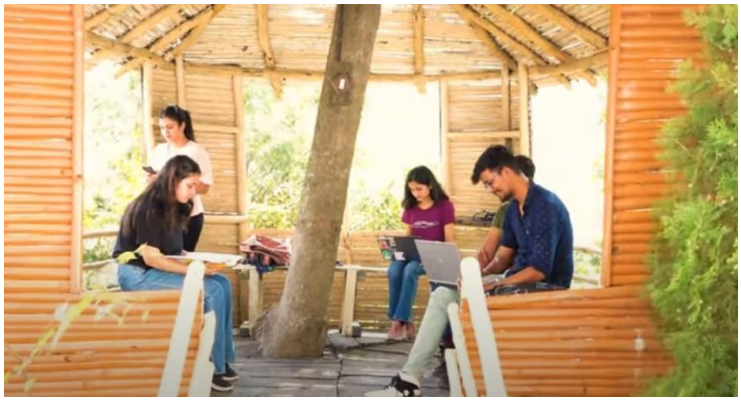


Figure 4: Living with Nature-Eco friendly Bamboo Tree Houses in the campus for student interaction

Figure 5: New School of Design Building made of Sustainable Materials

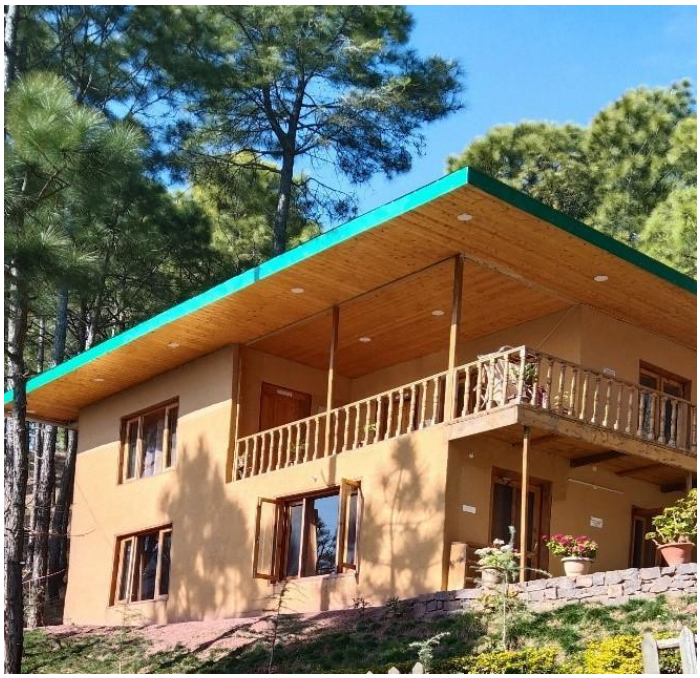


Figure 6: Sustainable building with mud walls in Yogananda Ville at Shoolini University.

Figure 7: Sustainable Building and Electric Vehicle for transportation in Yognanda Ville in Shoolini University

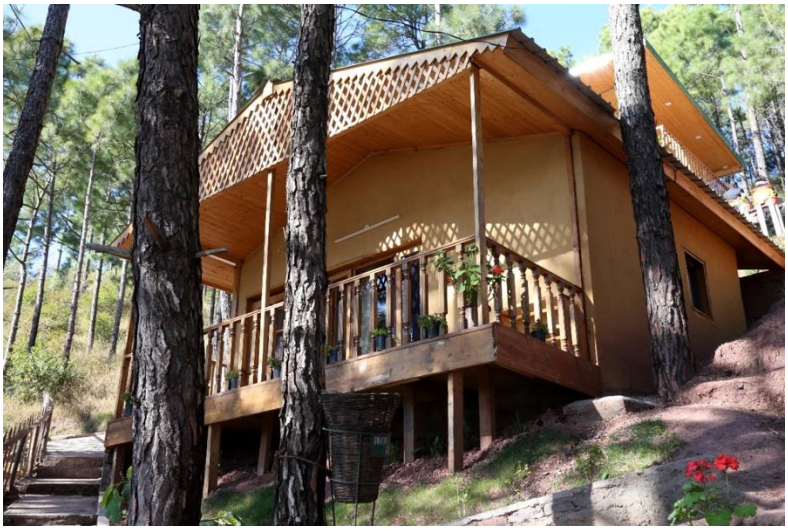


Figure 8: Guest house in Yogananda Ville built with sustainable materials and low carbon footprint

8 Climate Responsive - Green Campus with Vegetation Coverage

The university has ensured that adequate area is kept under trees, plants, and flowery plantation cover for an environment friendly green campus. As a measure of maintaining a clean and green campus separate dustbins for biodegradable and non-biodegradable wastes have been fixed in every part of the university campus. The University has been declared as "Zero single use plastic" Campus as per the policy initiative taken in 2021.

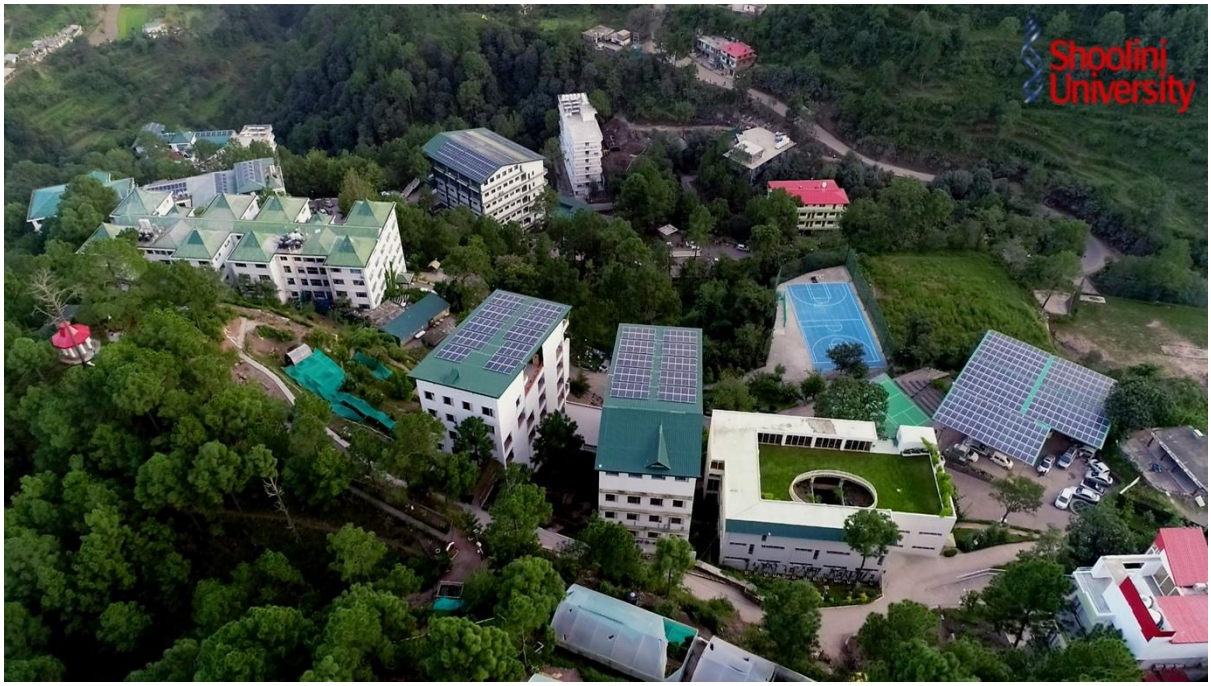


Figure 9: Aerial view of Green Campus various academic blocks of Shoolini University with visible tree plantations and photovoltaic power plants installed.

9 Reducing Carbon emissions and fossil fuel consumption for transportation in the campus -use of electric carts

Non-polluting electric vehicles are used for in-campus transport as shown in figure-11.

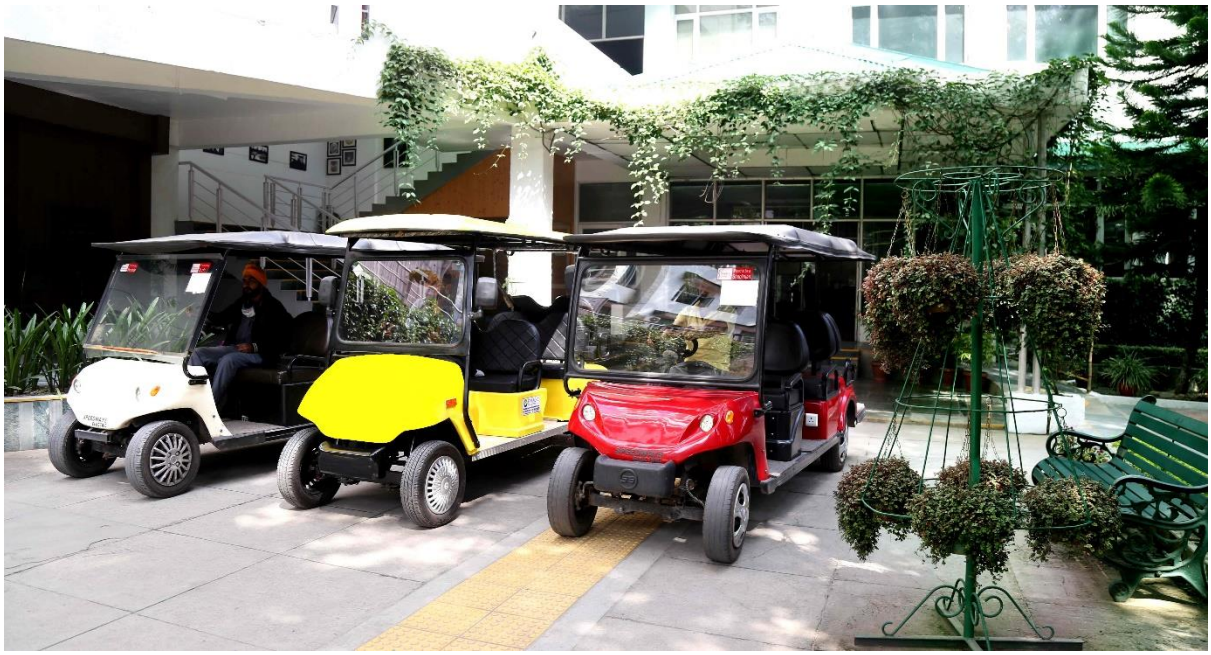


Figure 10: Electric vehicles used for transport within the university campus to reduce carbon emissions.

10 Use of non-polluting biogas and solar thermal cooking system : An alternative to LPG

As a step from divestment from use of liquid petroleum gas (LPG) for cooking the university has installed a solar thermal cooking system that provides for cooking food for 500 students. Also, a 1.5 m^3 biogas plant is installed in the agricultural farm in the university that is used for cooking food by the employees working in the farm.

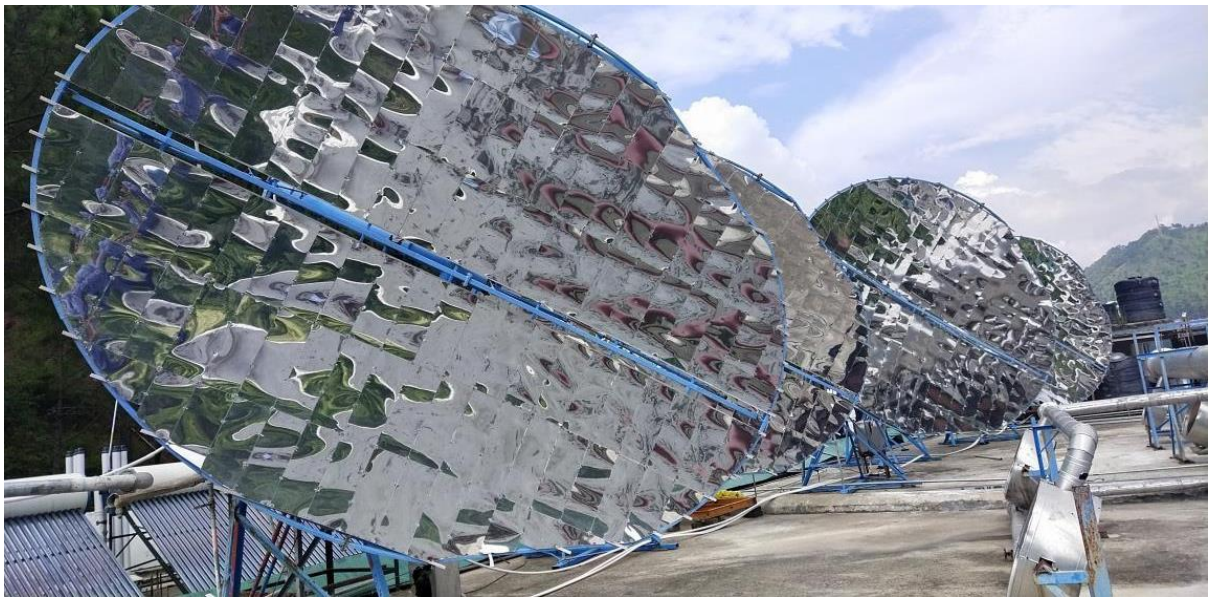


Figure 11: Steam cooking system for 500 students at Girls' hostel rooftop at Shoolini University

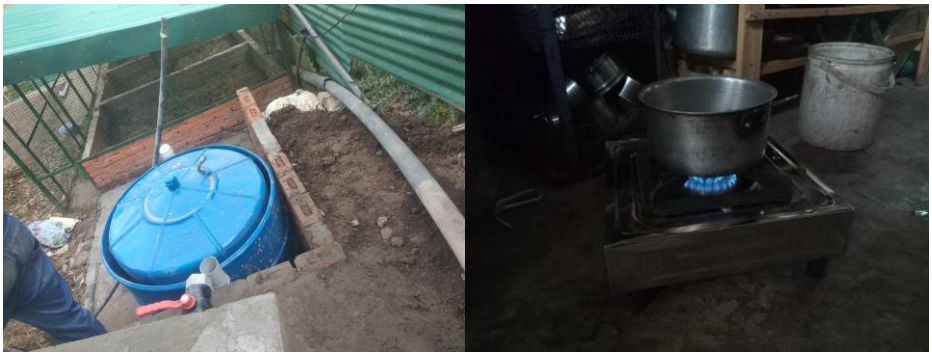


Figure 12: Biogas system installed in agricultural farm at Shoolini University

11 Reducing conventional electricity consumption by installing solar streetlights and LED lights in the campus

Solar streetlights are installed throughout the campus for lowering the dependence on conventional electricity and utilising clean energy sources. Also 90% of the university lights have been replaced with energy efficient LED lights.

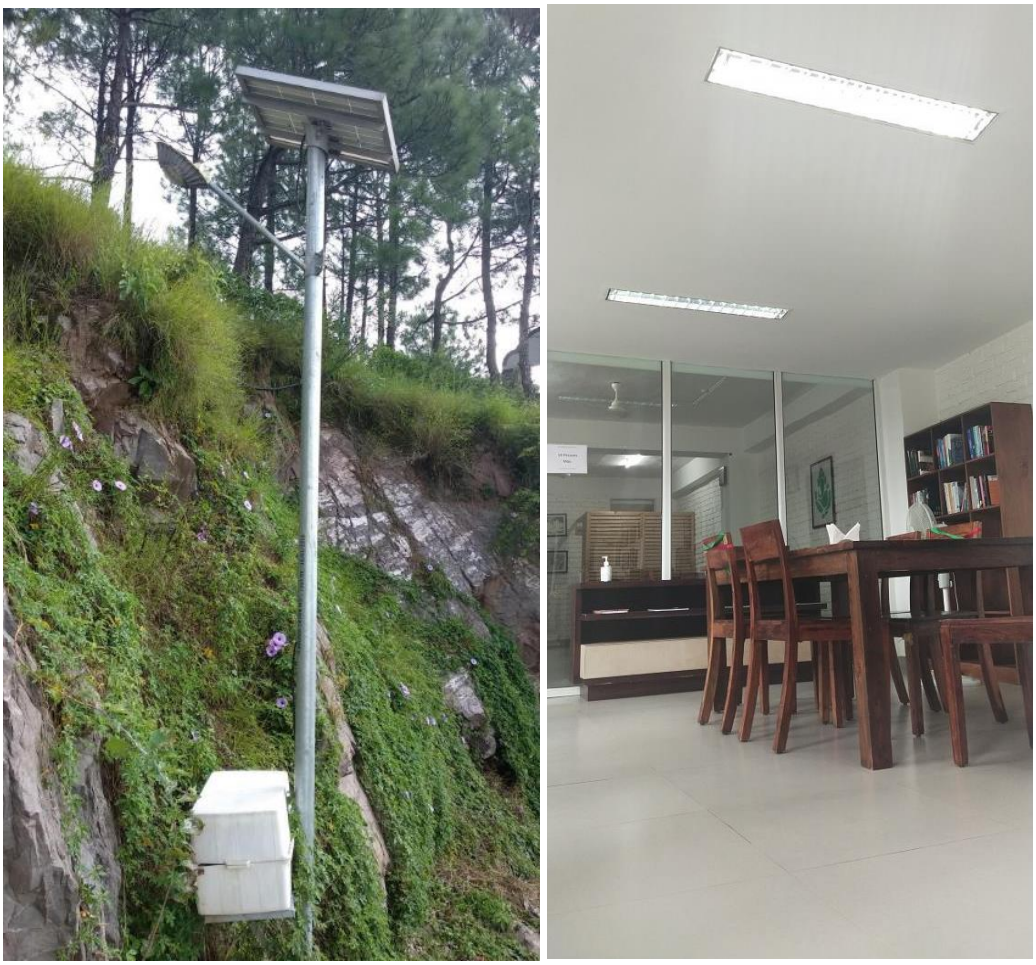


Figure 13: Utilizing clean Solar energy -Solar street lights installed in the university Campus(left) and use of energy efficient LED lights inside the university buildings (right)

12 Wastewater Treatment and recycling plant

A Sewage Treatment Plant of capacity 3,50,000 lpd and Effluent Treatment Plant of 50,000 lpd capacity, are installed in the campus for the treatment of sewage water and waste water coming from the hostels and research laboratories respectively. Recycled water is used for irrigation of gardens, fields and lawns.

13 Conferences, Webinars and other activities related to the promotion of SDGs

Shoolini University conducts conferences, webinars and awareness programmes throughout the year to contribute for the fulfilment of SDGs. Some of the activities are listed as follows:

1) On the occasion of International Day for biological diversity, an awareness session was organised at the Shoolini Institute of Life Sciences and Business Management(SILB).

   Evidence: https://himachaltonite.com/education/session-organised-on-biological-diversity-at-silb/

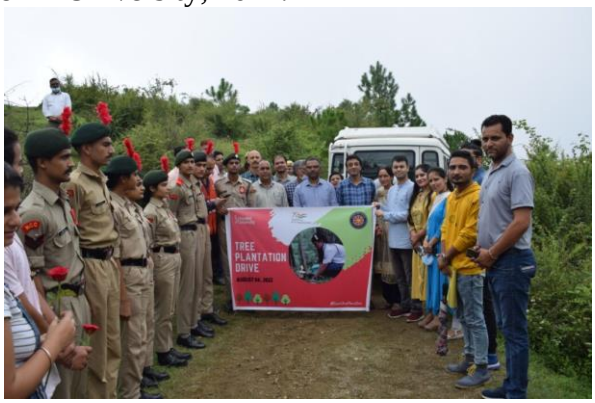
2) Shoolini Institute of Life Sciences and Business Management (SILB) organised various activities to mark the World Environment Day. These activities included tree plantation, Inauguration of Herbal Garden, Presentations, Quiz Competition, Best Out of Waste competition, Photography and Skits.

   Evidence: https://himachaltonite.com/education/silb-celebrates-environment-day/#:~:text=Shoolini%20Institute%20of%20Life%20Sciences,competition%2C%20Photography%20and%20Nukkad%20Natak%20.

3) World Soil Day was celebrated at Shoolini University by organising special lectures focusing on soil management for posterity.

   Evidence: https://himachaltonite.com/education/world-soil-day-celebrated-at-shoolini-university/

4) Plantation drive by Shoolini University, 2022.



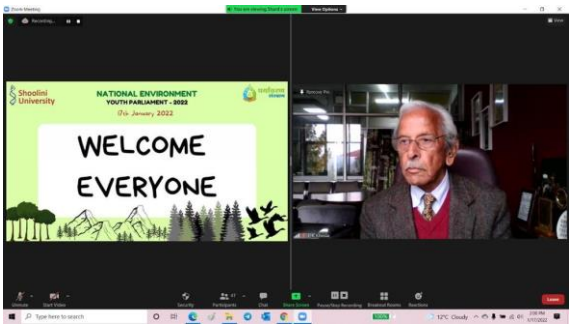
   Evidence: https://himachaltonite.com/himachal/tree-plantation-organised-by-shoolini-university/

5) Flower festival at Shoolini University 2022.

   Evidence: https://timesofindia.indiatimes.com/literary-minds-come-together-at-shoolini-litfest/articleshow/90793849.cms

   Video: https://www.instagram.com/tv/CcItYepjn4P/

6) The National Environment Youth Parliament 2022 – "Nurturing Environment Leaders" was organised by Paryavaran Sanrakshan Gatividhi (PSG) on an all-India level to sensitise the youth about the issue. The event was inaugurated by Chancellor of Shoolini University, Prof. Prem Kumar Khosla.



Evidence: https://crazynewsindia.com/breaking-news-flash-news/national-environment-youth-parliament-organise/

14 Research Publications in Energy and Environment Friendly Technologies

S. No.	Title	Authors	Year	Scopus Source title
1	Prospects of sustainable photovoltaic powered thermoelectric cooling in zero energy buildings: A review	Rahul Chandel | Shyam Singh Chandel | Deo Prasad | Ram Prakash Dwivedi	2022	International Journal of Energy Research
2	Review on thermoelectric systems for enhancing photovoltaic power generation	Rahul Chandel | Shyam Singh Chandel | Deo Prasad | Ram Prakash Dwivedi	2022	Sustainable Energy Technologies and Assessments
3	Research outcome of sustainable solar drying technology dissemination for preserving perishable agriculture and horticulture crops in the North Western Himalayan region of India	R.K. Aggarwal | Shyam Singh Chandel | Shiva Gorjian | Rahul Chandel	2022	Sustainable Energy Technologies and Assessments
4	Perspective of new distributed grid connected roof top solar photovoltaic power generation policy interventions in India	Rahul Chandel | Shyam Singh Chandel | Prashant Malik	2022	Energy Policy
5	A Novel Metaheuristic Approach for Solar Photovoltaic Parameter Extraction Using Manufacturer Data	Salwan Tajjour | Shyam Singh Chandel | Hasmat Malik, Majed A. Alotaibi | Taha Selim Ustun	2022	Photonics
6	Utilization of biodegradable novel insulating materials for developing indigenous solar water heater for hill climates	S Kaur | RJ Konwar | P Negi, S Dhar | K Singh | SS Chandel	2022	Energy for Sustainable Development

7	An experimental analysis of enhancing efficiency of photovoltaic modules using straight and zigzag fins	M Firoozzadeh | AH Shiravi | SS Chandel	2022	Journal of Thermal Analysis and Calorimetry
8	A Comprehensive Review on Four decades of Thermally Efficient Biomass Cookstove Initiatives for Sustainable Development in India	R K Aggarwal and SS Chandel	2022	International Journal of Ambient Energy
9	Impacts of environmental regulations on green economic growth in China: New guidelines regarding renewable energy and energy efficiency	Zhao, X.| Mahendru, M.| Ma, X.| Rao, A.| Shang, Y.	2022	Renewable Energy
10	Properties, optimized morphologies, and advanced strategies for photocatalytic applications of WO3 based photocatalysts	Shandilya, P.| Sambyal, S.| Sharma, R.| Mandyal, P.| Fang, B.	2022	Journal of Hazardous Materials
11	The role of renewable energy and natural resources for sustainable agriculture in ASEAN countries: Do carbon emissions and deforestation affect agriculture productivity?	Chopra, R.| Magazzino, C.| Shah, M.I.| Sharma, G.D.| Rao, A.| Shahzad, U.	2022	Resources Policy
12	Simultaneous Dual-Functional Photocatalysis by g-C3N4-Based Nanostructures	Akhundi, A.| Zaker Moshfegh, A.| Habibi-Yangjeh, A.| Sillanpää, M.	2022	ACS ES and T Engineering
13	Artificial leaf for light-driven CO2 reduction: Basic concepts, advanced structures and selective solar-to-chemical products	Kumar, A.| Hasija, V.| Sudhaik, A.| Raizada, P.| Van Le, Q.| Singh, P.| Pham, T.-H.| Kim, T.| Ghotekar, S.| Nguyen, V.-H.	2022	Chemical Engineering Journal
14	Emerging cocatalysts in TiO2-based photocatalysts for light-driven catalytic hydrogen evolution: Progress and perspectives	Xia, C.| Hong Chuong Nguyen, T.| Cuong Nguyen, X.| Young Kim, S.| Nguyen, D.L.T.| Raizada, P.| Singh, P.| Nguyen, V.-H.| Chien Nguyen, C.| Chinh Hoang, V.| Van Le, Q.	2022	Fuel

15	ZnO-based heterostructures as photocatalysts for hydrogen generation and depollution: a review	Dhiman, P.| Rana, G.| Kumar, A.| Sharma, G.| Vo, D.-V.N.| Naushad, M.	2022	Environmental Chemistry Letters
16	Regional Sustainable Development and Spatial Effects From the Perspective of Renewable Energy	Cai, X.| Wang, W.| Rao, A.| Rahim, S.| Zhao, X.	2022	Frontiers in Environmental Science
17	CO2 photoreduction into solar fuels via vacancy engineered bismuth-based photocatalysts: Selectivity and mechanistic insights	Kumar, A.| Singh, P.| Khan, A.A.P.| Le, Q.V.| Nguyen, V.-H.| Thakur, S.| Raizada, P.	2022	Chemical Engineering Journal
18	Revisting conventional and green finance spillover in post-COVID world: Evidence from robust econometric models	Sharma, G.D.| Sarker, T.| Rao, A.| Talan, G.| Jain, M.	2022	Global Finance Journal
19	Impact of artificial roughness variation on heat transfer and friction characteristics of solar air heating system	kumar, R.| Kumar, R.| Kumar, S.| Thapa, S.| Sethi, M.| Fekete, G.| Singh, T.	2022	Alexandria Engineering Journal
20	Recent advances in hydrochar application for the adsorptive removal of wastewater pollutants	Ighalo, J.O.| Rangabhashiyam, S.| Dulta, K.| Umeh, C.T.| Iwuozor, K.O.| Aniagor, C.O.| Eshiemogie, S.O.| Iwuchukwu, F.U.| Igwegbe, C.A.	2022	Chemical Engineering Research and Design
21	Properties, synthesis, and recent advancement in photocatalytic applications of graphdiyne: A review	Shandilya, P.| Mandyal, P.| Kumar, V.| Sillanpää, M.	2022	Separation and Purification Technology
22	Production and harvesting of microalgae and an efficient operational approach to biofuel production for a sustainable environment	Khan, S.| Naushad, M.| Iqbal, J.| Bathula, C.| Sharma, G.	2022	Fuel
23	Valorisation of xylose to renewable fuels and chemicals, an essential step in augmenting the commercial viability of lignocellulosic biorefineries	Narisetty, V.| Cox, R.| Bommareddy, R.| Agrawal, D.| Ahmad, E.| Pant, K.K.| Chandel, A.K.| Bhatia, S.K.| Kumar, D.|	2022	Sustainable Energy and Fuels

		Binod, P.| Gupta, V.K.| Kumar, V.		
24	Strategies based review on near-infrared light-driven bismuth nanocomposites for environmental pollutants degradation	Sudhaik, A.| Parwaz Khan, A.A.| Raizada, P.| Nguyen, V.-H.| Van Le, Q.| Asiri, A.M.| Singh, P.	2022	Chemosphere
25	Challenges and perspectives on innovative technologies for biofuel production and sustainable environmental management	Khan, S.| Naushad, M.| Iqbal, J.| Bathula, C.| Al-Muhtaseb, A.H.	2022	Fuel
26	The environmental impact of mass coronavirus vaccinations: A point of view on huge COVID-19 vaccine waste across the globe during ongoing vaccine campaigns	Hasija, V.| Patial, S.| Raizada, P.| Thakur, S.| Singh, P.| Hussain, C.M.	2022	Science of the Total Environment
27	Resolving energy poverty for social change: Research directions and agenda	Shahzad, U.| Gupta, M.| Sharma, G.D.| Rao, A.| Chopra, R.	2022	Technological Forecasting and Social Change
28	Activated Carbon as Superadsorbent and Sustainable Material for Diverse Applications	Sharma, G.| Sharma, S.| Kumar, A.| Lai, C.W.| Naushad, M.| Shehnaz| Iqbal, J.| Stadler, F.J.	2022	Adsorption Science and Technology
29	MXenes based nano-heterojunctions and composites for advanced photocatalytic environmental detoxification and energy conversion: A review	Sharma, S.K.| Kumar, A.| Sharma, G.| Vo, D.-V.N.| García-Peñas, A.| Moradi, O.| Sillanpää, M.	2022	Chemosphere
30	Influence of pyrolysis conditions of modified corn cob bio-waste sorbents on adsorption mechanism of atrazine in contaminated water	Binh, Q.A.| Nguyen, V.-H.| Kajitvichyanukul, P.	2022	Environmental Technology and Innovation

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36	Production of hydrogen and value-added carbon materials by catalytic methane decomposition: a review	Pham, C.Q.| Siang, T.J.| Kumar, P.S.| Ahmad, Z.| Xiao, L.| Bahari, M.B.| Cao, A.N.T.| Rajamohan, N.| Qazaq, A.S.| Kumar, A.| Show, P.L.| Vo, D.-V.N.	2022	Environmental Chemistry Letters
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