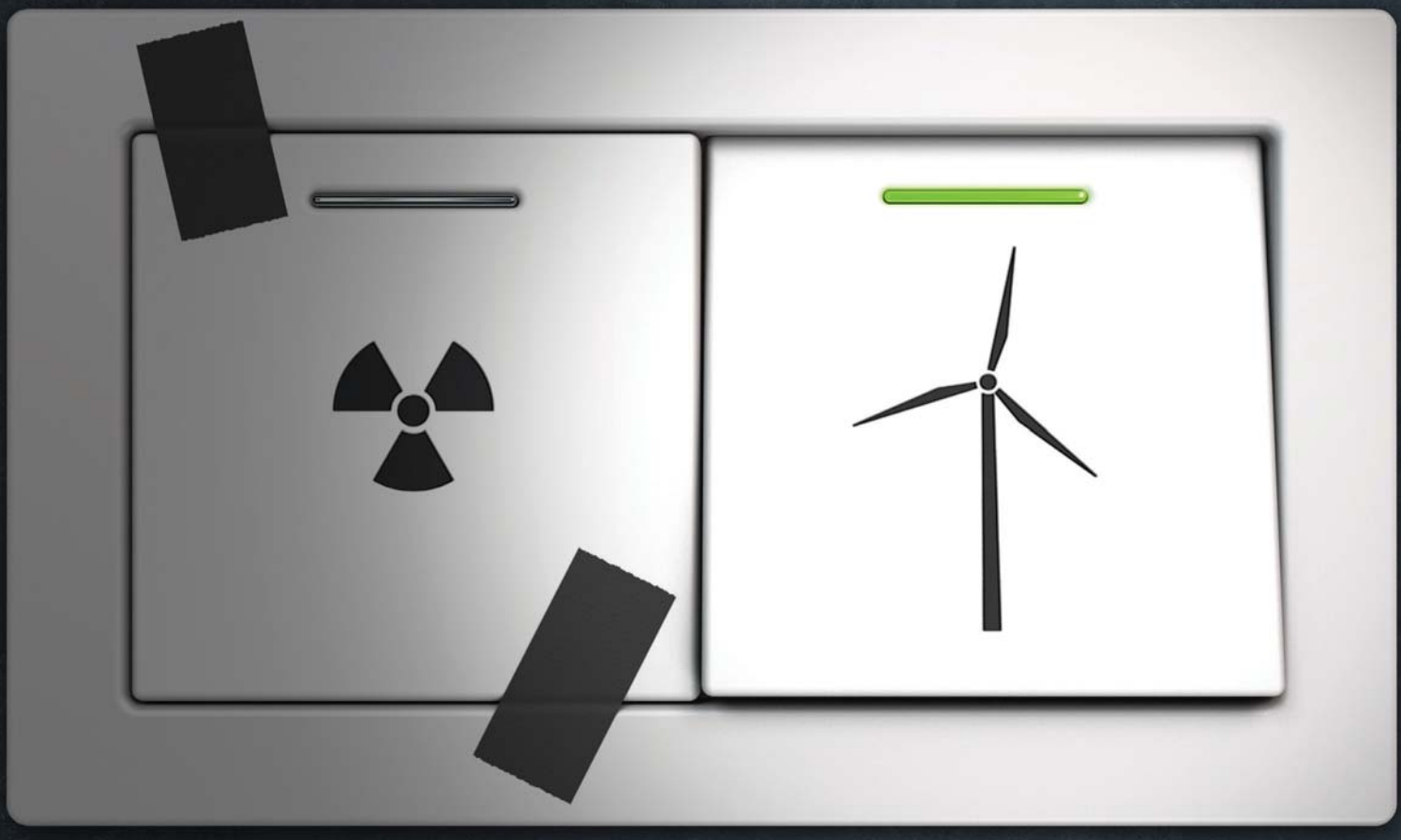


programmes to achieve transformation through the green economy. In India, besides rural growth, employment shall be the hallmark of holistic development in the solar field. IRENA's Director General, Mr Adnan Z Amin, has stated that the new data supports the agency's analysis that decarbonization of the global energy system can grow the global economy and create up to 28 million jobs in the sector by 2050.

The long list of positives to be achieved from the deployment of most dependable, the work horse crystalline silicon solar technology, are listed as follows:

1. Low gestation period
2. Low installation costs and ease in installation due to modular systems
3. Safe and non-hazardous manpower utilization
4. Reduced time and cost to carry out inspection and monitoring using Scada system
5. Low and easy maintenance using robots
6. Reduce repairs due to no moving parts
7. No noise pollution
8. High R&D potential for improvement in solar conversion efficiency
9. Availability of large installation sites, such as open grounds, building roof tops, mountains and valleys,
10. Floating on river/canal, sea shores,
11. Integrated in to exteriors of buildings- BIPV systems
12. Scope for cost reduction in per watt cost through automation and economy of scale
13. Grid parity achievable
14. Short energy payback period

15. Carbon neural and environmentally-benign technology
16. Levelized cost of electricity (LCOE)

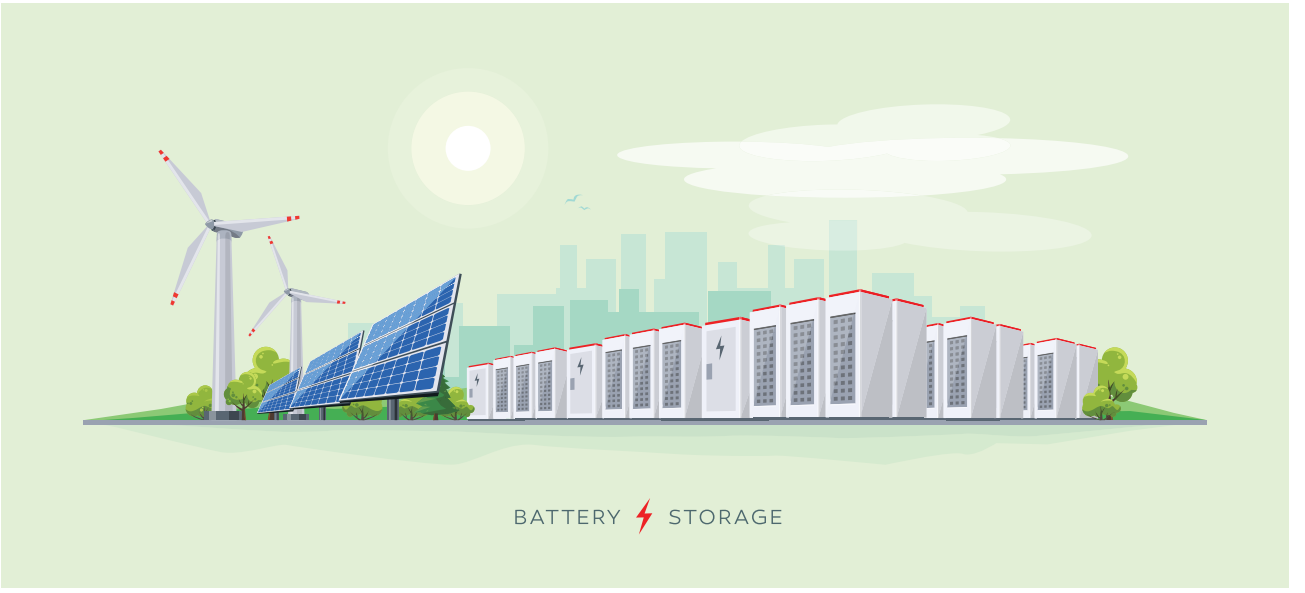
The 2017 Lazard Report shows that solar and other renewable energy's levelized costs continue to decline, with solar now far cheaper than conventional power technologies on an LCOE basis.

Technological Barriers Vis-a-Vis Infrastructural Needs

With Earth receiving solar energy equivalent to roughly10,000 times the world energy demand, solar power is greatly helping to transform the lives of millions through clean energy transition and affordable systems. Basically, per capita energy consumption is a measure of a nation's economic progress. However, solar resource has some technological barriers and limitations in terms of intermittency and lack of dispatchability in keeping the grid stable. The technological challenges encountered with the use of solar harvested power are being overcome by combining resilient practical solutions such as: a) hybrid solar–wind systems; b) battery-based energy storage systems (ESS), to provide demand side response and grid balancing, to reduce energy cost and improve efficiency interconnected energy operations. During the general assembly of ISA in New Delhi, the Prime Minister informed that India is working on the National Energy Storage Mission and the government is stressing on demand creation, indigenous manufacturing, innovation, and increased the capacity of energy storage.

An ESS stores the energy generated on windy or sunny days, and then supplies that stored energy on days that are calm or cloudy. For this reason, the ESS is vital to the sustainability and continuous development of renewable energy sources. Industries expect that, as climate change continues, ESS development will stimulate the growth of renewable energy industries. The overall benefits from a) and b) systems will result in increase in decentralization, efficient decarbonization, and adoptability to digitization.

The inadequacy in infrastructure for dedicated renewable energy (RE) power transmission through a common conventional power grid also leads to problems related to distribution, disturbance in frequency, and transformers. There have been discussions amongst India's decision makers on the importance of developing a smarter power transmission grid. With active involvement of the Power Grid Corporation of India, exclusive dedicated



cleaner infrastructure corridors for renewable energy are being developed to evacuate green energy on a large scale.

The issues related to non-availability of manufacturing infrastructure in India for the solar supply chain are also creating barriers in economic generation of RE power. The creation of an indigenous solar value-chain industrial set up in India without any dependency on foreign supplies is an essential need for large-scale manufacturing infrastructure.

The import of materials from various countries leads to quality problems, sub-standard and delayed supplies, and additional cost towards transportation and import duty. The various value-chain materials requiring 'Make in India' manufacturing are listed as follows:

1. Purified poly silicon material
2. Silicon ingots and crystals
3. Multi and mono silicon wafers
4. Silicon solar cells
5. PV modules arrays and structures
6. Industrial production machinery base for the solar components manufacturing
7. Chemical plants for the production of high purity gases and chemicals required for the solar industry
8. Availability of uninterrupted good quality power for the giga watt PV

Industrial set-up for production of solar value-chain materials

production requirements in the country.

Climate Change Reversal & Economic Growth Revival

With increasing preference, solar power by virtue of its adoptability and affordability is greatly established in:

» Clean power generation to help overall decarbonizing,
» Protecting nature in reducing carbon foot print,
» Leading to revival of global economy

Solar, being the focal point is the key to restrict climate change. Over reliance on fossil fuels has to be minimized at any cost globally. This year's *Renewable 2018 Global Status Report* (GSR) reveals two realities—one in which a revolution in the power sector is driving rapid change towards a renewable energy future, and the other in which the overall transition is not advancing with the required speed. The initiatives taken by ISA are highly crucial in setting a target of having at least 3 terawatts—or 3,000 giga watts (GW)—of additional solar power capacity by 2030, up from the current target capacity of 5 GW.

To demonstrate sustainability of development process, India has made major commitments and achievements in renewable energy. India's Prime Minister Shri Narendra Modi, assured at the ISA General Assembly inauguration session on October 2,2018, in New Delhi, about India's resolve to increase usage of renewable energy sources. He reiterated, "In India, we are seeing the effects of the greater use of renewable energy". The government has set an ambitious target in RE, that is, 175 MW capacity installations (out of which 100 GW will be for solar capacity) by 2022. Future extension to the intended target is 500 MW by 2030, which would help in successfully powering and digitizing economy of the country. Work has started on the action plan for the deployment of renewable energy. One of the main responsibilities for India remains to electrify each and every household in all its villages with quality power by 2022. By 2030, our 40% power capacity will be generated through non-fossil fuel-based resources.

All these measures shall lead to fulfilling the targets of the Paris Agreement with 197 signatory countries. The basic requirement of the agreement is to reduce GHG emissions in order to prevent the average global temperature from rising beyond 2 °C above the pre-industrial levels. It is believed that all member countries will play a proactive role in promoting the use of clean forms of renewable energy. India has been consolidating the roles of the partner agencies vis-a-vis their own mandate for facilitating technology transfer in the area of solar energy for focussing on capacity building; skill development; and raising project investment funding with global collaborations.

A major part of the solution lies in establishing indigenously, the key drivers for an upward growth through state-of-the-art industrialization for a robust energy infrastructure and capacity building. The following will accrue based on setting up of solar-based energy infrastructure together with the economic progress:

» Living in cleaner and safe planet
» Competing with rising utility costs
» Empowers women, health and literacy of children, and skilled jobs for men (solar youth force)
» Energy security independence
» Indigenous industrial base development
» Rural development and employment
» High strategic growth

Futuristic trends

Future is Solar: It is Here to Stay to Raise Quality of Life and Living Standards

ISA can be considered a futuristic platform where technology can help bridge the gap through large-scale transformation to meet the expectations at a global level. As ISA's active and founding partner, India is likely to take the lead to transform future business strategy with technological interventions and help drive the change in energy transition. The following

upcoming variants in solar technology need to be reviewed for achieving innovative outcomes in the future.

a. **Organic photovoltaic cells**: Recent research tests showed organic cells reaching 15% conversion rates, compared to about 22% conversion of absorbed sunlight to power by the crystalline silicon cells. Coupled with tandem cells, as per research findings, the two devices absorb different light wavelengths and achieve higher efficiency. This gives the option of generating more current more efficiently.

b. **PERC solar technology**: Amongst upcoming high-efficiency cell technologies, the PERC (passivated emitter and rear cell) is undoubtedly the most cost-effective. Compared with conventional cell, the production of PERC cell needs only to add rear passivation and laser slotting sections, coupled with metallization techniques. The cell's front side receives direct sunlight while the rear side soaks up scattered and reflected light. The additional features create a three-part advantage—a) a significant reduction in electron recombination; b) greater absorption of light; and c) higher internal reflectivity. These will effectively enhance energy generation in the cells.

c. **Bifacial PERC solar**: Bifacial PERC is also becoming an important route in the development of the solar technology. The commonly used manufacturing technology for bifacial PERC cell is to change the printing process of the PERC single-sided cell, and changing the rear surface from whole aluminium layer to a local aluminium layer. This allows incidental light on the rear surface to enter the cell from the exposed layer and create photoelectric conversion on both the front and rear sides. However, the most critical issue for bifacial module performance at the utility-scale is not the module but the tracker and mounting height of the system deployed. In this process, with negligible increase in manufacturing cost, bifacial PERC can achieve power generation gain of 10%–25% at the system level, which will significantly reduce the LCOE of the PV system while greatly enhancing the competitiveness and development potential of PERC technology. When bifacial modules are installed on a highly reflective surface, some bifacial module manufacturers claim up to a 30% increase in production just from the extra power generated from the rear.

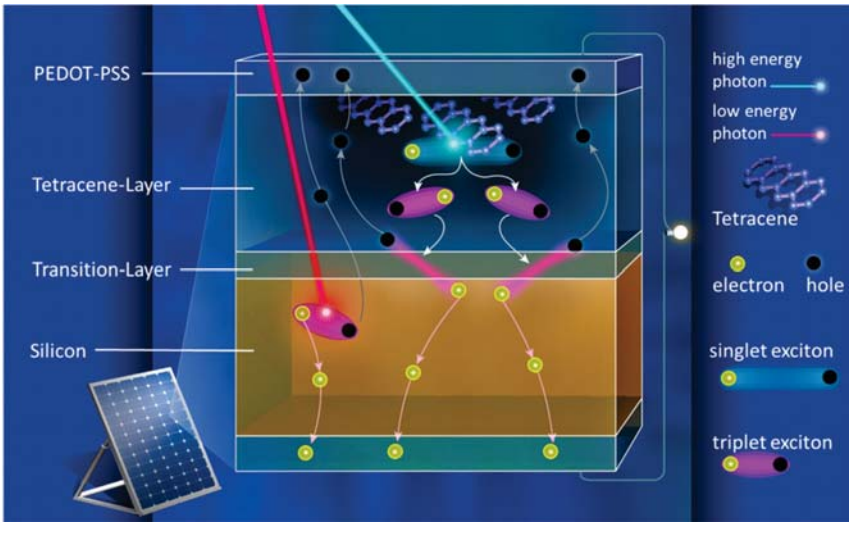
d. **Solar bifacial tracking systems**: Solar horizontal trackers are an essential tool for achieving higher energy production between 15% and 25% compared to fixed-tilt racking systems. It's also vital to consider optimal tracker layouts and site designs, as this can boost additional energy production. Bifacial technology demands special, idiosyncratic installation challenges in how those modules are mounted, how they sit, and how they tilt while considering the ground albedo, irradiance. Using trackers that are designed to improve power density are more effective.

Two major companies (ref. Soltec and Array Technologies) are setting up their Bifacial Tracking Evaluation Centres in the USA to evaluate scientifically the performance of bifacial PV modules and the tracking performance of single-axis trackers.

Bifacial solar panel on single axis tracker

e. Silicon hetrojunction cells: Silicon-based hetero-junction cells (being developed by the researchers at Berlin's Helmholtz Zentrum Research Institute) has an additional crystalline layer that utilizes an effect known as singlet fission (SF) to boost efficiency. The device demonstrates the principle and the researchers claim that the concept could achieve cell efficiencies as high as 40%.The SF effect has been observed in certain materials, and essentially allows one light particle (photon) to generate two electron hole pairs as it is absorbed, instead of just one, potentially doubling the efficiency of a solar cell. In their paper published *(ref.* journal *Materials Horizons)*, the study describes integrating a 100-nanometer thick layer of tetracene crystal – a material known to exhibit the SF effect – into the surface of an n-type silicon solar cell. An additional layer of organic polymer PEDOT: PSS is added to improve interactions at the layer interfaces.

As per the findings of the study, 'one of the main challenges is to separate the triplet pairs at the silicon interface without significantly disrupting the current flow of the silicon solar cell'.



Silicon hetrojunction cell developed at Berlin's HZR Institute

Conclusion

Traversing the path of renewable energy (RE) is an ever growing area for the sustainable future of humanity. Especially about electrical energy, which is known as the most convenient form of clean energy sources, the need for transition is emphasized while considering a steady growth in demand. As per the current status, the energy transition isn't happening fast enough to meet the climate targets of the Paris Agreement to prevent the average global temperature from rising beyond 2 °C above pre-industrial levels. The basic question is—what is the way forward to speed up the energy transition? The

growing concern of reducing carbon footprints through generation of green electricity from the infinite solar resource is receiving impetus to new advances in RE technology.

The IEA has the agenda to work with countries across the globe to implement climate-resilient decarbonization pathways. The IEA has estimated that renewable share of total global electricity generation will grow from 23% in 2015 to 28% by 2021. According to IEA, a cumulative investment of $53 trillion is required by 2035 in the energy sector alone. For the first time, the investment strategy encompasses the entire value chain spectrum within renewable sources such as wind power, solar, small hydropower, etc.

India possesses technological prowess in harvesting solar and wind energy for clean power with the aim of replacing carbon-based fuels. The various technical interventions are being put into action for transition in the form of grid stabilization, distributed generation, and using hybrid renewable sources and energy storage systems to take care of intermittency in supplies at installation sites. As the foremost player in energy transition with a bold environmental vision, the United Nations Environment Programme has bestowed Prime Minister Shri Narendra Modi and French President Emmanuel Macron with the 2018 'Champion of the Earth' award for their leadership in promotion of solar energy. India has the potential to be transformative in supporting the country's infrastructure development, and the skilled manpower to undertake and develop such gigantic industrial base for material manufacturing and PV projects.

The objective of reducing carbon footprints through generation of green electricity from the infinite solar resource, technological merit lies in innovative advancements and know-how transfers from the developed world. The REN21 report shows the inexorable rise of solar around the world. According to its report, globally, a remarkable growth trend continued, with 33% growth from 303 GW installed at the end of 2016 to 402 GW a year later. With a strong initiative for promoting ISA's technological merits through know-how transfer and further advancements, the Government of India has a determined aim of leading the world in the field of clean energy. The responsibility lies in meeting climate change challenge through harvesting of solar energy and its seamless evacuation on a mass scale with cost effectiveness within the time bound programme. EF

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SUSTAINABLE COMMUNITY COOKING SOLUTIONS

Universalization and ease of access to modern energy services is central to reducing issues related to health and degradation of the environment, poverty, and improving health care, employment opportunities, and lives of women and children. In India, more than 700 million people lack access to modern energy services for lighting, cooking, and other basic purposes. The sheer absence of these services forces women to spend a significant amount of their time and energy on usage of traditional methods of cooking; this in turn poses a risk to their health. In this light, **Professors S H Sengar, Tilak V Chavda,** and **Alok Singh**, elaborate, through a case study, on the evolution of modern and fuel-efficient cooking methods and their role in offering a sustainable energy solution.

Introduction

In Narmada district of Gujarat, biomass has a hugely positive potential. The total forest area in Narmada district is 1,20,494 ha, of which 74,238 ha forest area comes under Dediapada taluka only. Most of rural household, residential, and non-residential schools and small hotels used biomass-based traditional appliances (*chulhas*) for community cooking. It is a well-known fact that the traditional cooking stoves (*chulhas*) do not comprise an energy-efficient process and unburnt part of the biomass fuel (wood) escapes as smoke which consists of carbon dioxide, carbon monoxide, methane, and hydrogen, causing pollution and also wastage of a large amount of heat into the atmosphere. The proper utilization of fuelwood in developed technology will not only increase the thermal efficiency but also liberate the flue gases at lower temperature in the atmosphere. Based on these views, an efficient biomass gasifier-based cooking system has been developed for the purpose of the community at large.

About Developed System

Before developing a new cooking system, the performance of traditional cooking system used in the tribal villages was evaluated. The capacity of a developed cookstove displayed the energy required for meeting the heat

required to cook the meals per batch. The physical parameters of traditional cooking system, food habit and quantity, fuel type and its consumption rate, time required for cooking, amongst other details, were considered while developing the cooking system.

The cookstove reactor has a 0.3 m and 0.4 m inner and outer dia. respectively, with 0.8 m height. The burner diameter is 0.3 m and height is 0.07 m. Hopper having 0.07 m dia. is provided for achieving the desired size fuel supply in stove. An area of 0.071 m^2 grate is placed at 0.1 m height in the bottom. The grate is used to provide the platform for fuel and ash fall in ash pit. Two numbers of primary air inlets with 0.05 m dia. and 0.10 m length is provided to produce the draft inside the stove. Twenty secondary air inlets, 15 mm in size have been provided with burner for adequate air supply to complete combustion at the top of stove. Ash chamber of 0.36 m dia. and 0.1 m height is provided to collect the ash formed in cookstove. Reactor chamber is placed for gasification of incomplete combustion of biomass. Sufficient insulation is provided to reduce heat loss from inner to outer body. As the weight of the gasifier is higher, four caster wheels are provided for easy transport and handling. The complete shape of the outer body appears like a funnel. By using this device, meal for around fifty people can be prepared. Thus, this device is known as funnel shape biomass gasifier for community cooking/thermal application. The IS standard material is used for fabrication of this device. Thus, the life of the gasifier is around 10 years without any major maintenance. The material cost and fabrication cost of developed cookstove stands at ₹5,800 and ₹4,300, respectively.

Evaluation of the Developed System

The operating parameters, tabulated further ahead, are recorded during the evaluation of the developed system. The developed cookstove was evaluated for thermal application. The thermal profile of the stove reactor at different height from grate and flame temperature was evaluated. The analysis of the feedstock was studied for the proximate analysis and calorific value estimation.

Operational characteristics

The performance evaluation of a developed cookstove was carried out using the selected fuel, *Tectona grandis* and *Butea monosperma*. The performance tests were undertaken by loading the cookstove reactor with rated loading capacity. The results obtained from the series of test runs are as shown in the table on the next page.

The average start-up time is 2.5–3 min and is contingent on the amount of fuel igniting material used. The average operating time of fully loaded stove was found to be 107.5 min with average total operating time is 112.50 min. The average total fuel consumed during the test was found to be 7.75 kg. Based on the above results, the

Parameter	Methodology
Start up time, min	Time required for igniting the wood
Operating time, min	Duration of flame start to end
Total operating time, min	Duration of wood ignition to flame end
Total fuel consumption, (kg)	Fuel occupy inside the cookstove entire run time
Fuel consumption rate, kg/h	Fuel consumed during total operating time
Sp. combustion rate, kg/h.m^2	(Weight of fuel used, kg) / (reactor area, m^2 × Operating time, h)
Boiling time, min.	Time taken by water to its boiling point
Combustion Zone Velocity, m/h	(length of reactor, cm) / (operating time, min)
Thermal efficiency, %	
Power Input, kW	Pi = 0.0012 × FCR × HVF
Power Rating, kW	Po = 0.0012 × FCR × HVF × th
Ash produced (%)	(mass of char, kg) × 100 / mass of fuel used, kg)
Thermal profile of cookstove	Zone-wise temperature inside the reactor above grate at height of 16 cm (z4),17 cm (z3), 18 cm (z2), and 19 cm (z1) was measured by using the K-type (Chromel-Alumel) digital thermometer at an interval of 5 minutes starting from the ignition of the fuel to the end of the test run
Economic evaluation	(a) Net present value (b) Benefit cost ratio (c) payback period

$$= \sum_{t=1}^{t=n} \frac{B_t - C_t}{(1+i)^t} \qquad = \sum_{t=1}^{t=n} \frac{B}{(1+i)^t} \Big/ \sum_{t=1}^{t=n} \frac{C}{(1+i)^t}$$

Parameter	*Butea monosperma*	Tectona grandis	Avg.
Fuel, kg	8.00	7.50	7.75
Start up time, min	3.00	2.50	2.75
Operating time, min	110.0	105.0	107.5
Total operating time, min	115.0	110.0	112.5
Fuel consumption rate, kg/h	4.20	4.10	4.13
Sp. combustion rate, kg/h/m^2	59.10	57.90	58.49
Combustion zone velocity, m/h	0.37	0.38	0.37
Wt. of utensil, kg	3.2	3.2	3.2
Sp. heat of utensil, kcal/kg °C	0.2	0.2	0.2
Weight of water, kg	21	21	21
Initial temp. of water, °C	27.80	28.50	28.15
Boiling temp. of water, °C	100	100	100
Boiling time, min	50	40	45
Water evaporated, kg	8.00	7.50	7.75
Latent heat of water, kcal/kg °C	540	540	540
Sensible heat of utensil, kcal	49.28	48.64	48.96
Sensible heat of water, kcal	1516.20	1501.50	1508.85
Latent heat evaporation of water, kcal	4320.0	4050.0	4185.0
Heat output, kcal	5885.50	5600.10	5742.81
Heat input, kcal	28,616.00	28,237.50	28,426.75
Thermal efficiency, %	20.50	19.80	20.19
Power input, kW	17.90	17.60	17.76
Power rating, kW	3.60	3.50	3.55
Ash produced (%)	2.8	1.7	2.3

average specific combustion rate was determined as 58.49 kg/m/h. Based on fuel consumption and height of reactor, the average combustion zone rate was found to be 0.37 m/h. The average thermal efficiency of developed cookstove was found to be 20.19%. The average input in terms of heat energy was 28,427 kcal. The average power input of open top gasifier was found to be 17.76 kW. The average power output of developed cookstove was found to be 3.55 kW. The final product of combustion, that is, ash produced was 2.3%.

Thermal efficiency by water boiling test

The water boiling test of developed cookstove was carried out to evaluate the thermal performance. The average thermal efficiency of developed cookstove was found to be 20.19%. The higher thermal efficiency of developed cookstove than the traditional biomass cooking system revealed the enormous scope for fuel saving.

Thermal profile of combustion zone

The variation of temperature at different height from the grate of stove reactor and flame temperature with respect to operating time of the reactor was measured. Figure 1 reveals the thermal profile of cookstove. The temperature was measured at every 5 min interval from the ignition of stove upto the end of process. The stove is of open top, the wood was lit-up from the top. Hence the hot bed moves from top to bottom of stove up to the grate into the reactor. During initial phase of time, the temperature was higher at the Zone-1 and goes on decreasing up to the ambient at Zone-4. After 55 min, the condition changed and higher temperature was observed at Zone-4 and lower temperature observed at Zone-1. In Zone-1, the gradual rise in temperature from 400 °C to 560 °C was observed during initial 30 min of operation. The gradual decrease in temperature upto 532 °C was observed in Zone-1 till 80 min of operation. The gradual decrease in temperature from upper zone during the operation of stove indicates the movement of char towards the grate. In Zone-2, the gradual rise in temperature from 53 °C to 733 °C was observed during initial 50 min of operation. It showed that the hot bed moved from Zone-1 to Zone-2. The maximum temperature attend by the Zone-2 was 733 °C. The gradual decrease in temperature up to 588 °C was observed in the 80 min of interval. The gradual decrease in temperature from Zone-2 during the stove indicates the movement of char towards the grate. Zone-3 remains in the range of 740 °C to 900 °C up to 115 min of operation and thereafter, a gradual fall of temperature was observed till the end of process. Zone-4 remains in the range of 900 °C to 1100 °C up to 130 min and thereafter, the temperature decreases gradually till the end of process. The outer body temperature of cook stove remains constant in the range of 150 °C to 225 °C till the end of the process. Outer body temperature of cook stove rise from ambient to 225 °C was achieved in 105 min of operation. It is observed that the maximum temperature attained by the flame was found to be 504 °C and this reveals how an adequate amount of heat is produced for cooking by a developed cookstove.

Comparison

The comparison between developed cookstove and traditional system for fuel saving are summarized as shown in the table below. The average fuel consumption rate was found to be 4.13 kg/h in developed cookstove whereas 8 kg/h was found in traditional cooking system.

Parameters per batch	Cookstove	Chulha
	Average	Average
Start-up time (min.)	2.75	3.00
Operating time (min.)	108	75
Total operating time (min.)	113	79
Total fuel consumed (kg)	7.75	10.10
Fuel consumption rate (kg/h)	4.13	8.10
Fuel saved in traditional system (kg/h)	-	3.97

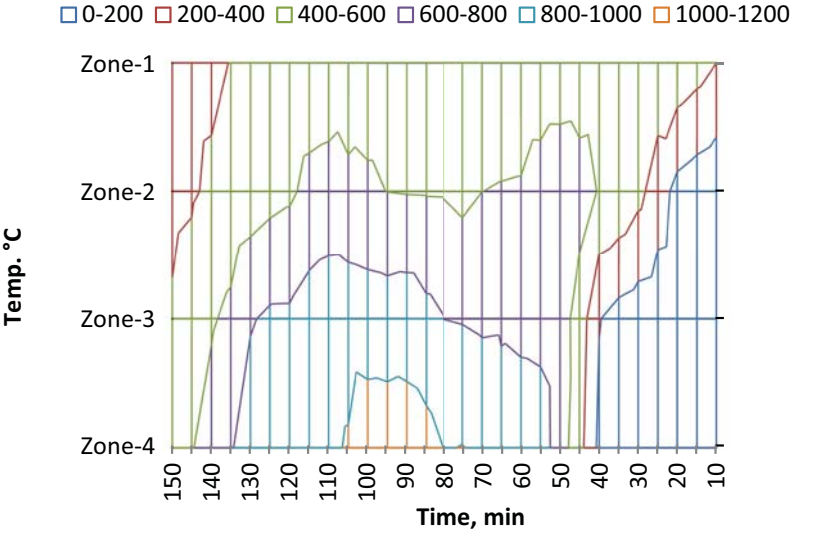

Figure 1 Thermal profile of cookstove

Economic Evaluation

Economic evaluations were undertaken on the basis of cash inflow and outflow statement of the developed cookstove. The present worth was observed as ₹1,11,165/- over the basic price of a developed cookstove as ₹10,100/- in 10 years. Thereafter, it can be concluded that the developed cookstove is economical and involves considerable saving in wood of ₹30,876/- per annum as compared to the existing system. The cost-benefit cost ratio was calculated by dividing present worth of benefit stream with the present worth of cost stream and found to be 2.5 for cooking using the cookstove. The payback period of cooking system was found to be 4.36 months for the initial investment of cookstove. The payback period of less than one year implies that the developed cookstove is economically feasible for the cooking application.

Conclusion

The calorific value of *Tectona grandis* and *Butea monosperma* were found as 3765 kcal/kg and 3577/kg, respectively. The average thermal efficiency using water boiling test was found to be 20.19% using teak and khakra wood with dimension 5 cm to 7 cm in diameter and 30 cm to 35 cm long as feedstock for community cooking at the PAED boys hostel. The average fuel saving was found to 3.97 kg/h by using developed cook stove over the traditional cooking system. The annual net saving was found as ₹30,876 with utilization of developed cookstove over the traditional cooking system at the PAED boys hostel. The economic evaluation of the cook stove concludes that the net present worth (₹), benefit-cost ratio, and payback period was found to be ₹1,11,165/-, 2.5, and 4.36 months, respectively, and revealed its economically feasibility for cooking applications.

Acknowledgements

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THE 10TH GRIHA SUMMIT 2018

December 11th-13th 2018 | New Delhi

Fostering Partnership for Sustainable Habitat

The GRIHA Summit is the annual flagship event organized by GRIHA Council in association with key stakeholders in construction industry to discuss and deliberate on furtherance of sustainable habitat development in India.

The GRIHA Summit has in the past played host to various technical sessions on sustainable building policies, tools & techniques, and exhibitions showcasing sustainable building materials, techniques, and technologies. The theme for past editions of the GRIHA Summit has always been in line with the policies and initiatives of the Government of India and endeavoured to contribute towards the noble nation building activity of sustainable development. The GRIHA Summit brings together experts from industry, finance policy and consumers to develop and drive new initiatives; provide insights, and showcase sustainable products and green business opportunities. It also facilitates sharing of international best practices from all across the world to elicit practical applications that are most relevant in the Indian context.

The GRIHA Summit is an ideal event to showcase your business to

Launch of GRIHA for CITIES Rating at the Curtain Raiser & Inaugural session to the 10th GRIHA Summit on December 10, 2018, at Taj Palace, New Delhi, by Ms Harinder Sidhu, Australian High Commissioner to India; Mr Abhay Bakre, Director General, Bureau of Energy Efficiency (BEE); Prof. Ian Jacobs, President & Vice Chancellor, University of New South Wales (UNSW), Sydney, Australia; Dr Ajay Mathur, President, GRIHA Council & Director General, TERI; and Mr Sanjay Seth, Chief Executive Officer, GRIHA Council

Launch of *Material Handbook on Sustainability* at the 'Setting the Theme session' to the 10th GRIHA Summit on December 11, 2018, at India Habitat Centre by Prof. Ian Jacobs, President & Vice Chancellor, University of New South Wales (UNSW), Sydney, Australia; Dr Ajay Mathur, President, GRIHA Council & Director General, TERI; Mr Sanjay Seth, Chief Executive Officer, GRIHA Council; and Dr Winfried Damm, Director, Indo-German Energy Programme (IGEN), Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

the leading minds in government, the industry and education. GRIHA Council works with partners to integrate their products/services/skills into the conference, ideally in a way that augments the delegates' experience and advances each sponsor's goals. GRIHA Council can deliver on a wide variety of goals- thought leadership, generating borrowed interest via media (print, online, social), introduction to individual delegates, product demo or showcase, branding, etc.

The 2018 edition of the Summit, marked the tenth year and was based on the theme, 'Fostering Partnerships for Sustainable Habitats'. As in the past, the Summit served as a platform to deliberate on interdependence between organizations, systemic sustainability management, and feedback loops for better resource efficiency. The Summit, held during 11–13 December, 2018, at Indian Habitat Centre (IHC), New Delhi, witnessed the presence of eminent speakers and dignitaries around the world who gathered to debate, discuss, and deliberate on the aspects of sustainability in the context of inclusiveness, international cooperation, and education.

GRIHA Council

Green Rating for Integrated Habitat Assessment (GRIHA) Council is an independent, not- for -profit society jointly setup by TERI and the Ministry of New and Renewable Energy (MNRE), Government of India, to promote and administer green buildings in India. GRIHA was adopted as the National Rating System for Green Buildings in India by the Ministry of New and Renewable Energy, Government of India in 2007. GRIHA has been acknowledged as the tool to evaluate reduction in emission intensity through habitats, as part of mitigation strategy for combating climate change in India's 'Nationally Determined Contributions' (NDCs) submitted to the United Nations Framework Convention on Climate Change (UNFCCC). GRIHA rating works on the underlying principle of 'What gets measured gets managed'. EF

“RECYCLE YOUR THOUGHTS”

The two watchwords of the present century—sustainable and recycle—inspired Vishnupriya S, Architect and now a filmmaker, to deviate from her comfort zone and create a documentary on ‘ecological’ toilets. As part of her social project, she envisioned designing a toilet that consumes less water, especially in government schools. Her relentless pursuit of viable methods to reduce, reuse, and recycle the huge volume of waste produced in the country on a daily basis, has led to alternative solutions. In an email interview with *Energy Future*, *Vishnupriya S* unravels her motivation behind being a closet environmentalist and how she has taken up the cudgels of sustainability.

Please take us through your journey from being architect to an environmental filmmaker and tell us how you stumbled upon the eco-san toilet concept. What was the kind of field work that went into collating information?

I had been practicing architecture for 6 years but after a point, I was more inclined towards Earth Architecture*. It was during this period that I started travelling for workshops and meeting new people who were working on similar lines. One such workshop took me to 'Cuckoo Forest School', located close to Thiruvannamalai. It was here that I met Mr Siva Raj, one of the founders of 'Cuckoo Movement for Children' and 'Cuckoo Forest School'. My interactions with him and there forth, a lot of questions I had within myself that I decided to do a social project; that is, design a public toilet (using earth-friendly materials) that consume less water.

By this point of time, I was completely sure on pursuing only 'Earth Architecture'. The reason being the insight shared by one of my good friends, Boobalan, a social/environmental activist, on how construction debris was being dumped onto the Vaigai river in my hometown, Madurai. This disturbed me to a great extent. With water scarcity issues at hand, we were here polluting the water bed with materials that wouldn't decompose for years together. My research on 'toilet models that would consume less water' introduced me to the concept of converting fecal waste into manure and thereon, the eco-san toilet model. Initially, all of it was online and book-oriented research.

However, my quest to acquire a first-hand experience, led me to witness one such toilet and this is what took me to Musiri near Trichy, Tamil Nadu. Herein, there is a public toilet, based on the 'eco-san' model that caters to the needs of the residents of the area. Significantly, there are no toilets in the houses in the district. Although this was a public toilet, I had never seen a prettier or neater toilet in my entire life. The place was full of plants, there was no foul smell, and it was well maintained.

It was my visit to this place that gave me the confidence that an alternative sustainable toilet model is possible.

Thereafter, I also visited the garbage compost yard in Musiri and witnessed first-hand, a simple yet novel method of handling our garbage. Even a week later, I was constantly thinking and talking about the things I saw in Musiri. There were two questions that haunted me.

One is, although in architecture schools, none of these sustainable toilet models had even been introduced to us but these services are equally important as much as functionality and aesthetics. Being urban and town planners, planning and mapping places for services such as these (sewage and garbage) are equally important

* The most natural form of architecture which doesn't use concrete or cement but uses mud and stones.

in the planning of a new city. Without these in place, we shall have the cities coming down in a few years like how we are seeing things right now. Services are however given the least of importance in city planning. Second, if this (the compost yard) was working so well in one place, then why wasn't it implemented in the other places whereas all we see are mounting garbage piles. And it was from here that we decided to document this.

The initial idea was to make a video for Facebook. When we started out, we never thought it would turn out to become this huge. It was because of the people I met and the things I learnt during my research, that the documentary grew organically from thereon. I should rather say that I grew along with this documentary.

Were you shocked by the reality of waste and water disposal that you witnessed? How did it inspire you to make a documentary?

Yes, indeed I was quite shocked. Once I started meeting experts, environmentalists as well as sanitary workers, the harsh reality was like a slap on my face. When you learn and understand the reasons behind the problems and the source of these problems, then you become more determined to curb it or at least reduce it.

Could you take us through a few waste management concepts you learnt about during the shooting of the film?

As far as sanitation is considered, I was introduced to the eco-san toilet model, DEWATS (Decentralised Wastewater Treatment Systems), and a couple of other experimental models which haven't become very popular like the first two. I also have my doubts about their possibilities and consequently their success ratio.

For garbage, the solid–liquid resource management (SLRM) is one of the best models I have come across when it comes to handling waste at a macro level.

What, according to you, is tougher—building an eco-san toilet or changing people's mindset?

Changing the mindset of people and getting them to use such a toilet model is the foremost and biggest challenge. Once that is achieved construction of eco- san toilet shall follow suit automatically. When people shall understand why we need this, then the job is done.

We are used to flushing and not seeing our fecal waste thereafter. But in this case, the biggest mind block is to accept that our fecal waste can be converted into a more usable form and can be handled by our very own hands. Once the inhibition to this is broken, it shall be fairly easy to convince people.

The course of your research took you to Tamil Nadu, Andhra Pradesh, and parts of Karnataka. Are you planning to take your work to other parts of the country and if yes, tell us about the same?

We have travelled a great deal in Tamil Nadu and as far as the other parts of country are concerned, we have travelled to Bengaluru, Hyderabad, Delhi, and Ladakh. Since this is a global problem and not restricted to one region, we have travelled to major problem areas in due course of time. We also intend to make the documentary in Tamil as well as English.

As someone who witnessed garbage/waste in all its stark actuality during the course of your work, how optimistic does the future India look?

In recent times, there is an increasing awareness of the damage to the environment, particularly at the domestic level. Especially where it concerns plastics, there is definitely change taking place both on the civic and civil fronts. However, plastic alone is not the issue when it comes to waste. Instead of tackling issues when they have already worsened, it is always wise to foresee the problems or danger that something might cause to everything and everybody around us.

For instance, e-waste is an equally threatening issue but we as a country, no dialogue has been initiated on the same. Therefore, for smooth resolution, greater awareness, more constructive dialogues, and stronger policies is the need of the hour.

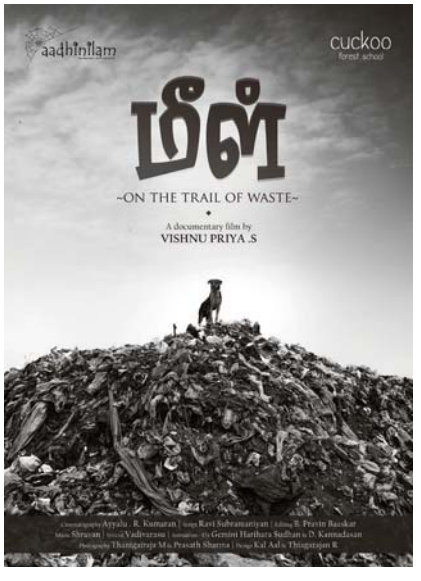
If one were to observe carefully, garbage, sewage, water contamination and scarcity, climate change, and many other similar interconnected problems that are intertwined. One problem can only cause another problem if not nibbed at the source. The problem is that we, as the common people, are ignorant to the environmental and heath damage accruing as a result of our actions. In fact, this is where 'Meel' and its impact plays an important role.

We definitely have a long way to go but I am keeping my hopes on the positive side.

According to you, how prudent is the principle of reduce, reuse and recycle, in tackling waste management?

There are actually 5 Rs—Reduce, Refuse, Reuse, Recyle, and Rot and this is totally the way forward.

- First, we need to cut down on our consumption culture. The more we buy, the more we consume and the more waste we will generate.
- Second, we need to refuse what we don't need or what can't be reused, recycled or composted.
- Third, we need to reuse which also includes repair; the repair culture is out of fashion now. All we do is use and throw—be it electronics or furniture. We are obsessed with buying new things all the time so we want to discard what we already have.
- Fourth, when you recycle, you end up not taking raw materials from nature, thus saving up on resources. The more you don't recycle, the more natural resources we shall be depleting.
- Fifth, bearing in mind the concept of 'rot', when we practice composting, we shall be eliminating 60% to 70% of our daily garbage which then becomes easier to handle.



As mentioned earlier, it is totally the way forward and our willingness to act sustainably.

Could you elaborate on 'sustainable architecture' and its pressing need today?

'Sustainable Architecture' or 'Sustainable Construction' is the need of the hour. What we take from nature should rightfully go back (to nature) in the purest form possible. What we are seeing now is an increasing concrete jungle without an end in sight. The starting point to this is the fact that we see property as an investment and status; most of us easily have more than one residence in a city.

Food, shelter, and clothing were designed only for our protection from climate and outside predators. However, when these transform into a luxury product, it leads to chaos in the system. The act of cutting down trees to build concrete structures more than perhaps our requirement, further contributes to climate change. With farmlands being converted into properties, we are paving the way for food shortage.

Also, greater usage of concrete is only going to increase the indoor and outdoor temperature which will definitely harm our body and mind while in an earth or stone structure, the inside is naturally cool when it is warm outside or vice versa. Also in keeping with the concept of 'sustainability', we should be careful to not take much from nature, such as cutting trees, etc. It would be best to use recycled materials.

How has working on this documentary changed you as a person?

I had lived a very comfortable life prior to this with all my needs and demands being met. I too was a consumerist; buying off things because I liked them and not needed them. But now, I respect the resources that nature has provided us with and understand that the best way forward is to use them in the minimum limits possible. These days, when I see a room filled with things, it unconsciously disturbs me. I find my peace in minimalism. I now recognize the difference between 'wants' and 'needs'.

Similarly, my respect for water and for the sanitary workers who handle our waste on our daily basis has increased in multiple folds. I realize that if they don't turn up for a day or two, then our streets would be filled with filth and stench. They end up taking all our dirt and yet we call them dirty. That's the irony. EF

CURRENT R&D RENEWABLE

Short-long term anomaly detection in wireless sensor networks based on machine learning and multi-parameterized edit distance

Information Fusion, Volume 52, December 2019, Pages 13–30

Francesco Cauteruccio, Giancarlo Fortino, Antonio Guerrieri, AntonioLiotta, Decebal Constantin Mocanu, Cristian Perra, Giorgio Terracina, Maria Torres Vega

One of heterogeneous wireless sensor networks are a source of large amount of different information representing environmental aspects such as light, temperature, and humidity. A very important research problem related to the analysis of the sensor data is the detection of relevant anomalies. In this work, we focus on the detection of unexpected sensor data resulting either from the sensor system itself or from the environment under scrutiny. We propose a novel approach for automatic anomaly detection in heterogeneous sensor networks based on coupling edge data analysis with cloud data analysis. The former exploits a fully unsupervised artificial neural network algorithm, whereas cloud data analysis exploits the multi-parameterized edit distance algorithm. The experimental evaluation of the proposed method is performed applying the edge and cloud analysis on real data that has been acquired in an indoor building environment and then distorted with a range of synthetic impairments. The obtained results show that the proposed method can self-adapt to the environment variations and correctly identify the anomalies. We show how the combination of edge and cloud computing can mitigate the drawbacks of purely edge-based analysis or purely cloud-based solutions. EF

Real time calorimetric characterisation of clay – drug complex dispersions and particles

International Journal of Pharmaceutics: X, Volume 1, December 2019, 100003

A M Totea, I Dorin, G Gavrilov, P R Laity, B R Conway, L Waters, K Asare-Addo

Isothermal titration calorimetry (ITC) along with attenuated total reflectance Fourier transform infrared spectroscopy (ATR-FTIR), scanning electron microscopy with energy dispersive X-ray spectroscopy (SEM/EDX) and high-performance liquid chromatography (HPLC) were employed to investigate the process of adsorption of propranolol hydrochloride (PPN) onto magnesium aluminium silicate (MAS) and to characterise the MAS-PPN particles formed upon complexation. The composition of MAS was confirmed by infrared (IR) spectroscopy and a calcimeter. The calorimetric results confirmed the binding between PPN and MAS at various pHs and temperatures. The overall change in enthalpy was found to be exothermic with a comparatively small entropic contribution to the total change in Gibbs free energy. These findings suggest that the binding process was enthalpically-driven and entropically-unfavourable (lower affinity) suggesting hydrogen bonding and electrostatic interactions dominating the interaction. The variation of pH and temperature did not have a great impact on the thermodynamics of the binding process, as observed from the similarity in enthalpy (ΔH), entropy (ΔS) or Gibbs free energy (ΔG). A slight reduction in the binding affinity (Ka) with varing pH and temperature was however observed. SEM/EDX studies showed the occurrence of changes in the microstructural properties of MAS following complexation which may explain the potential of MAS-PPN complexes for controlled drug release promoting pharmaceutical innovation.. EF

Data fusion based coverage optimization in heterogeneous sensor networks: A survey

Information Fusion, Volume 52, December 2019, Pages 90-105

Xianjun Deng, Yalan Jiang, Laurence T. Yang, Man Lin, Lingzhi Yi, MinghuaWang

Sensor networks, as a promising network paradigm, have been widely applied in a great deal of critical real-world applications. A key challenge in sensor networks is how to improve and optimize coverage quality which is a fundamental metric to characterize how well a point or a region or a barrier can

be sensed by the geographically deployed heterogeneous sensors. Because of the resource-limited, battery-powered and type-diverse features of the sensors, maintaining and optimizing coverage quality includes a significant amount of challenges in heterogeneous sensor networks. Many researchers from both academic and industrial communities have performed numerous significant works on coverage optimization problem in the past decades. Some of them also have surveyed the current models, theories and solutions on the problem of coverage optimization. However, most of the existing surveys and analytical studies ignore how to exploit data fusion and cooperation of the deployed sensors to enhance coverage performance. In this paper, we provide an insightful and comprehensive summarization and classification on the data fusion based coverage optimization problem and techniques. Aiming at overcoming the shortcomings existent in current solutions, we also discuss the future issues and challenges in this area and sketch a general research framework in the context of reinforcement learning. EF

Performance and emission characteristics of diesel engine fueled with rice bran biodiesel and n-butanol

Energy Reports, Volume 5, November 2019, Pages 78–83
Geetesh Goga, Bhupendra Singh Chauhan, Sunil Kumar Mahla, Haeng Muk Cho

Due to the depletion of petroleum products and fatal emissions from the tailpipe of diesel engines it has become a need to seek for the alternative of petroleum products for long-term use. Currently, researchers and experts have come to the conclusion that biodiesel along with higher alcohols can be an appropriate substitute for this situation. Former investigations have presented that biodiesel and higher alcohol can help in improving the performance and depreciating harmful exhaust gases in a diesel engine. In the current investigation blends of diesel, rice bran biodiesel and n-butanol were prepared to check its effect on performance and emission characteristics of a diesel engine. Biodiesel was prepared by single stage alkaline transesterification process in this study and after that blends of diesel–biodiesel and diesel–biodiesel-n butanol were prepared as B10, B20, B10 nb10 and B20 nb20. Then these blends were tested in a single cylinder, small utility diesel engine with a rated power output of 3.73 kW to compare them with baseline diesel. Experimental investigation demonstrates that blends of rice bran biodiesel and n-butanol can be used as a fuel in a diesel engine without any change in the engine. EF

Porous V_2O_5 nanofibers as cathode materials for rechargeable aqueous zinc-ion batteries

Journal of Energy Chemistry, Volume 38, November 2019, Pages 20–25
Xuyong Chen, Liubin Wang, Hang Li, Fangyi Cheng, Jun Chen

Rechargeable aqueous zinc-ion batteries are recently gaining incremental attention because of low cost and material abundance, but their development is plagued by limited choice of cathode materials with satisfactory cycling performance. Here, we report a porous V_2O_5 nanofiber cathode with high Zn-storage performance in an aqueous $Zn(CF_3SO_3)_2$ electrolyte. We propose a reaction mechanism based on phase transition from orthorhombic V_2O_5 to zinc pyrovanadate on first discharging and reversible Zn^{2+} (de) intercalation in the open-structured hosts during subsequent cycling. This open and stable architecture enables a high reversible capacity of 319 mAh g^{-1} at 20 mA g^{-1} and capacity retention of 81% over 500 cycles. The remarkable electrochemical performance makes V_2O_5 a promising cathode for aqueous zinc-ion batteries. EF

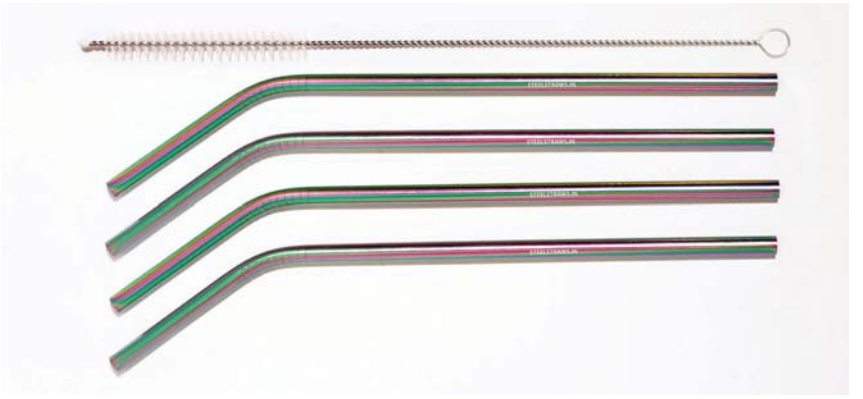
CHANGE THE WORLD, ONE STRAW AT A TIME

Ranging from fizzy drinks to mocktails to milkshakes and juices, straws—fancy, plastic, colourful— form an integral part of the drinks served worldwide. The sheer number of plastic straws—or single use plastic, if you please—in use today are to a large extent responsible for ocean pollution and harming sea life.

As an alternative, reusable straws are gaining popularity; the stainless steel straws in particular, are the best since these are easy to clean, practical, and simple to use. These follow the maxim of 'drink, wash, and repeat'. In addition to being environment friendly and reusable, these stainless steel straws are easy to clean, free from toxic chemicals and BPA, rust free, hygienic, and dishwasher safe.

The History of Using Straws

Going back to the history of how plastic usage became common, it would not be wrong to say that human negligence has led humankind to arriving at the cusp of environmental and health disasters. According to the United Nations data, up to 1970s, a very small amount of plastic was used and therefore, it could easily be managed. However, two decades later the production has increased almost threefold. The surge in the use of plastic was continuous and as a result, today, we produce nearly 300 million tonnes of plastic every year. In other words, as much plastic waste is generated each year as the weight of the entire human population. The biggest culprit behind this problem is the single-use plastic products. As the name suggests, the single-use plastic products are the ones that are used just once and then thrown away, thus,



becoming a part of enormous amount of plastic garbage. These single-use plastic products are found everywhere, such as the polyethylene terephthalate (PET) bottles, high-density polyethylene (HDPE) containers, potato chip bags, polyethylene carry bags, plastic cutlery, hot drink cups, protective packaging made from polystyrene, etc.

About Stainless Steel Straws

Stainless steel (SS) straws, as the name suggests, are made up of stainless steel material. It does not get rusted and are very easy to clean. These straws have the amazing build quality and can be carried along wherever you go. Steel straws easily fit your pockets, are super light, and are a zero-waste version of plastic straws. Their greater features are discussed as follows:

100% reusable product

Our planet is in jeopardy because we waste more and recycle less. Expecting a change in this situation implies a more active role by us all. Put a stop over the use of plastic straws and try SS straws. These are 100% reusable products which add to its charm. The straws are dishwasher safe and come with a cleaning brush. It is very easy to take care of your steel straws, all you need to do is to wash it with soap water or put it inside the dishwasher. The brush is used to clean inside the straw that is why they can be reused n-number of times.

Stop the throwaway culture

The throwaway culture is nothing but the non-stop and careless methods of trash disposal, primarily attributed to sheer laziness. We duly understand how harmful plastic straws are, yet we seldom do enough to support the cause. Metal straws offer the right solution to stop the throwaway culture. These straws are quite durable, reusable, and convenient for use since these can be easily carried within our pockets without any issue and enjoy the drinks without harming the environment. This will also inspire others to ditch plastic straws and get rid of throwaway culture for good.

Eco-friendly & attractive alternatives

Metal straws are super attractive, no doubt about it. They look extremely stylish and are an eco-friendly alternative to the plastic ones already available in the market. Moreover, these do not add any metallic taste to the drinks. Unlike plastic straws, they do not take centuries to get decomposed and reduce our plastic footprint. So, these are essentially better for your planet and perhaps the best drinking straws in use till date.

Long Lasting

These reusable straws are made up of tough, durable material that can last for years. These are the best alternative option that is very practical and perfect for use. Drink, wash, and repeat. The metal straws could easily last a lifetime considering one does not lose them. Also, each steel straw one uses leads to saving of a thousand plastic ones from reaching the oceans and harming the environment. Doing our bit is now more crucial than ever. In fact, usage of these straws constitutes a perfect way to express care and love for planet Earth.

Super light and cost-effective

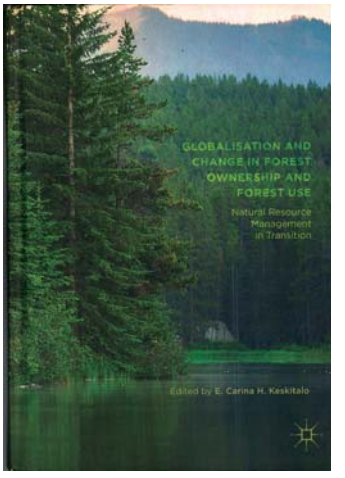
The metal drinking straw is super light for use. These straws easily fit inside your pockets and you can easily store/carry them within your bag. They take very little space in your bag so you can easily bring your own wherever you go. Also, they are extremely cost-effective as compared to plastic straws. Considered as a zero-waste version of plastic straws, metal straws are a smarter option for the environment that does not cost much.

Buy from us—Steel Straws.in

In the light of all the amazing benefits and protection of the environment, our initiative, Steel Straws, offers an exciting list of stainless steel straws. These straws are of the highest quality and include collapsible, flexible, bend straws, and straight straws. Our featured collection is for everyone and we even provide wholesale packs of these straws. EF

Globalisation and Change in Forest Ownership and Forest Use: Natural Resource Management in Transition

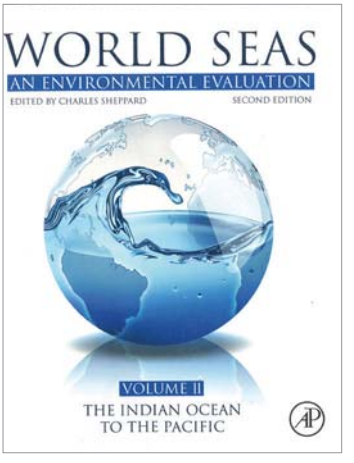
This book describes the changing landscape of European forest ownership and explores the impact a new, often urban, generation of forest owners may have on the future of one of our most basic resources—forests. Forests have not played a major role in rural studies thus far, however they constitute an important part of many rural areas. Drawing on Swedish cases and comparison cases from various other areas of Europe, the authors present these 'new forest owners' as a pivotal factor in the changing relationships between urban and rural life. The chapters explore how forest production, the relationship to the environment, urban-rural relations and local communities have already changed as well as discussing what might be expected for the future. A result of work in the Swedish research programme PLURAL and related projects, such as the EU Cost Action FACESMAP, this volume will be of interest to scholars of forestry and rural studies, as well as to researchers in environmental, population and globalization studies more broadly. EF



Editor: E Carina H Keskitalo
Publisher: Palgrave Macmillan;
Year: 2017

World Seas: An Environmental Evaluation: Volume I: Europe, The Americas and West Africa

World Seas: An Environmental Evaluation, Second Edition, Volume One: Europe, The Americas and West Africa, provides a comprehensive review of the environmental condition of the seas of Europe, the Americas and West Africa. Each chapter is written by experts in the field who provide historical overviews in environmental terms, current environmental status, major problems arising from human use, informed comments on major trends, problems and successes, and recommendations for the future. The book is an invaluable worldwide reference source for students and researchers who are concerned with marine environmental science, fisheries, oceanography, and engineering and coastal zone development. EF

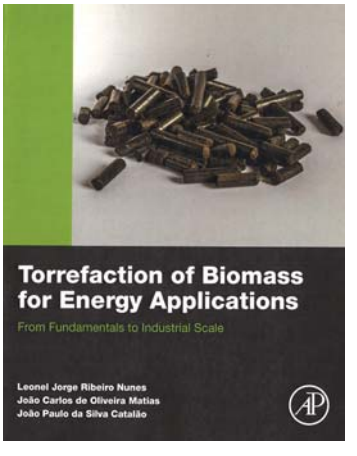


Editor: Charles Sheppard
Publisher: Academic Press
Year: 2018

Torrefaction of Biomass for Energy Applications: From Fundamentals to Industrial Scale

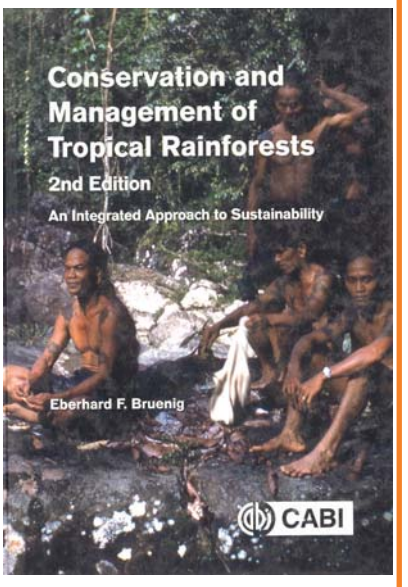
Torrefaction of Biomass for Energy Applications: From Fundamentals to Industrial Scale explores the processes, technology, end-use, and economics involved in torrefaction at the industrial scale for heat and power generation. Its authors combine their industry experience with their academic expertise to provide a thorough overview of the topic. Starting at feedstock pre-treatment, followed by torrefaction processes, the book includes plant design and operation, safety aspects, and case studies focusing on the needs and challenges of the industrial scale. Commercially available technologies are examined and compared, and their economical evaluation and life cycle assessment are covered as well.

Attention is also given to non-woody feedstock, alternative applications, derived fuels, recent advances, and expected future developments. For its practical approach, this book is ideal for professionals in the biomass industry, including those in heat and power generation. It is also a useful reference for researchers and graduate students in the area of biomass and biofuels, and for decision makers, policy makers, and analysts in the energy field. EF



Authors: Leonel JR Nunes, Joao Carlos De Oliveira Matias, Joao Paulo Da Silva Catalao
Publisher: Academic Press
Year: 2017

Conservation and Management of Tropical Rainforests

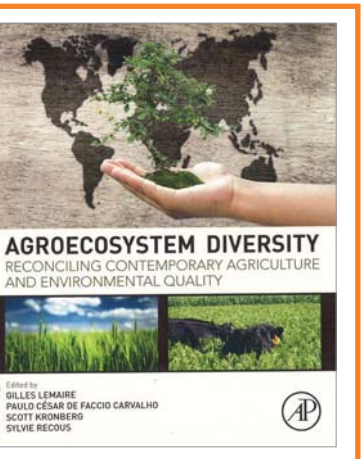


Author: Eberhard F Bruenig
Publisher: CABI Publishing

This new edition of *Conservation and Management of Tropical Rainforests* applies the large body of knowledge, experience, and tradition available to those who study tropical rainforests. Revised and updated in light of developments in science, technology, economics, politics, etc., and their effects on tropical forests, it describes the principles of integrated conservation and management that lead to sustainability, identifying the unifying phenomena that regulate the processes within the rainforest and that are fundamental to the ecosystem viability. Features of the natural forest and the socio-cultural ecosystems which can be mimicked in the design of self-sustaining forests are also discussed. A holistic approach to the management and conservation of rainforests is developed throughout the book. The focus on South-East Asian forestry will be widened to include Africa and Latin America. Recent controversial issues such as biofuels and carbon credits with respect to tropical forests and their inhabitants will be discussed. This book is a substantial contribution to the literature and is a valuable resource for all those concerned with rainforests.

Cover Photo: The group of five Iban resting on rocky cliffs in the Ulu Katibas in 1957 were traditional shag (Sect. 2.2, p. 86) farmers from the longhouse of Penguluh Ngali in the steep-hilly Ulu Ai (Ai river headwaters) below the Lanyak Entimau Protected Forest in the PFE (see p. 339). They were part of the native Iban complement in an exploratory survey by F.G. Browne, (Chief) Conservator of Forests Sarawak and Chairman of the Iban Resettlement Board, myself as SFO Kuching and team leader, and my assistant, D. Parson. We had crossed the watershed eastward along a former headhunter trail and got lost for an additional week in the legendary, fascinatingly wild, almost virgin-primary, timber- and biodiversity/species-rich Mixed Dipterocarp Forest (MDF, see pp. xiv and 397) of the Ulu Katibas-Kapuas hill country. Our mission was to assess three alternative land-use options: logging and conversion to production forestry; agriculture; or TPA-NP (pp. xiv-xv). Our conclusion at the end of the crossing was that only TPA - NP was feasible; the Iban farming community had to be resettled on better, more suitable land and soil in Northern Sarawak. Upon returning to Kuching, we recommended the creation of a large, continuous TPA-NP. Iban villagers, tribal leaders and the Government (Governor Sir Anthony Abell) agreed. Strict adherence to the decreed Forest Policy (see pp. 171-173) and the application of the classic phronesis approach (see p. 341) had ensured the establishment and survival of large tracts of MDF and other forest types as TPA, such as the Batang Ai National Park (20,040 ha), Ulu Sebuyau National Park (18,287 ha) and Lanyak Entimau Wildlife Sanctuary (182,983 ha), and enabled their inclusion in the current Malaysian (Sarawak and Sabah)-Indonesian transboundary 'Heart of Borneo' programme of biodiversity, species preservation, nature conservation and environmental protection (Photo EFB, 1957). EF

Agroecosystem Diversity: Reconciling Contemporary Agriculture and Environmental Quality



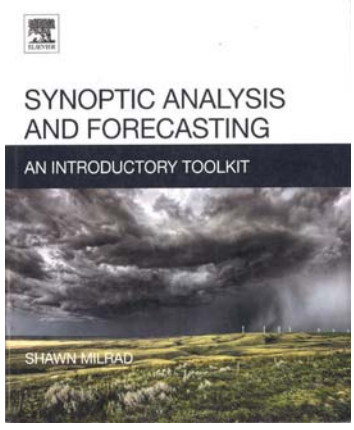
Author: Gilles Lemaire, Paulo Cesar de Faccio Carvalho, Scott Kronberg, Sylvie Recous
Publisher: Academic Press
Year: 2018

Agro-Ecosystem Diversity: Impact on Food Security and Environmental Quality presents cutting-edge exploration of developing novel farming systems and introduces landscape ecology to agronomy. It encompasses the broad range of links between agricultural development and ecological impact and how to limit the potential negative results. Presented in seven sections, each focusing on a specific challenge to sustaining diversity, the book provides insights toward the argument that by re-introducing diversity, it should be possible to maintain a high level of productivity of agro-ecosystems while also maintaining and/or restoring a satisfactory level of environment quality and biodiversity.

» Demonstrates that diversified agro-ecosystems can be intensified with environmental quality preserved, restored and enhanced
» Includes analysis of economic constraints leading to specialization of farms and regions and the social locking forces resisting to diversification of agro-ecosystems

Presents a global vision of world agriculture and the trade-off between a necessary increase in food production and restoring environment quality EF

Synoptic Analysis and Forecasting: An Introductory Toolkit



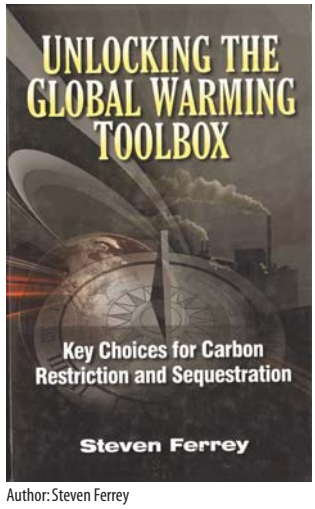
Synoptic Analysis and Forecasting: An Introductory Toolkit provides the bridge between the introductory fundamentals of a meteorology course and advanced synoptic-dynamic analysis for undergraduate students. It helps students to understand the principles of weather analysis, which will complement computer forecast models. This valuable reference also imparts qualitative weather analysis and forecasting tools and techniques to non-meteorologist end users, such as emergency/disaster managers, aviation experts, and environmental health and safety experts who need to have a foundational knowledge of weather forecasting.

» Presents the fundamentals of weather analysis and forecasting
» Offers clear accessible writing aimed at students from a variety of mathematical backgrounds

Discusses the reading and interpretation of surface observations and METAR code, processes associated with the motion and intensity of cyclones and anticyclones, and quantitative and/or qualitative diagnosis of processes associated with ascent and descent. EF

Author: Shawn Milrad
Publisher: Elsevier
Year: 2017

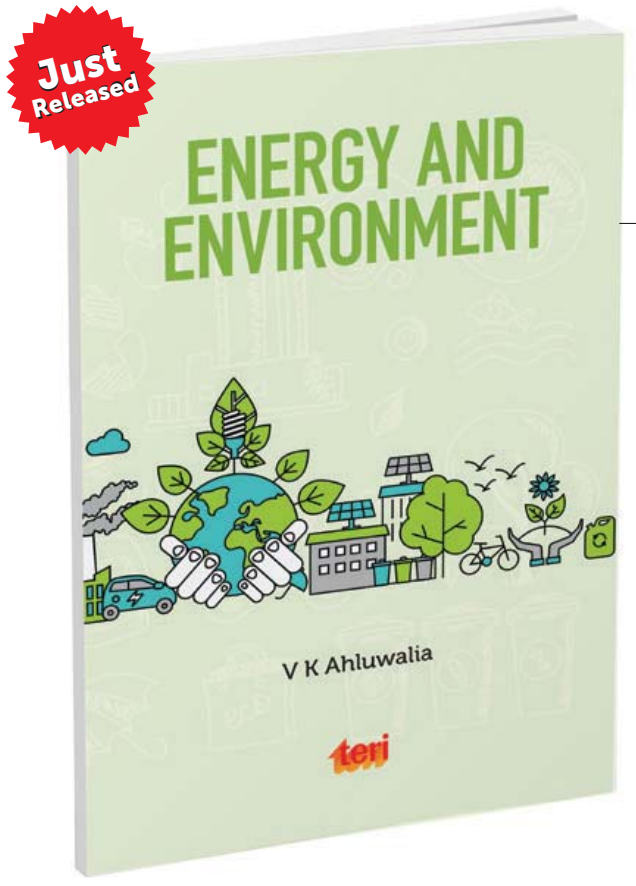
Unlocking the Global Warming Toolbox: Key Choices for Carbon Restriction and Sequestration



Unlocking the Global Warming Toolbox is the first and only book to focus on the key options for designing and implementing equitable and goal-specific carbon regulation. This book is a regulatory toolkit holding the policy and legal implements necessary to shape the carbon future. It showcases the ongoing legal and regulatory issues that will be worked out both in the United States and in international programs for years, and highlights the lasting issues related to crafting successful carbon control. *Unlocking the Global Warming Toolbox* is a must-have for those who would regulate carbon and those who would be subject to that regulation—policymakers, regulators, industry, non-governmental organizations, and consumers. EF

Author: Steven Ferrey
Publisher: PennWell Books
Year: 2010

RENEWABLES: GLOBAL SOLUTION TO ENERGY AND POLLUTION



Major topics covered

- Types of Alternative Fuels
- Storage of Energy in Chemicals
- Energy from Coal
- Geothermal Energy
- Greenhouse Gases
- Fuel Cells
- Nuclear Fusion
- Energy Sources

ISBN: 9789386536610 • Price: ₹195.00

Energy and Environment discusses various forms of energy. It examines environmental impacts of energy generation and how non-renewable sources of energy contributes significantly to environmental pollution. In the book the role of renewable energy sources in mitigating global problem of environmental pollution is also discussed at length. It also elaborates on storage of energy, an important subject, in the context of rising energy demands of the present world.

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RENEWABLE ENERGY TECHNOLOGY DEVELOPMENT

Climate change: How could artificial photosynthesis contribute to limiting global warming?

After several years during which global emissions at least stagnated, they rose again somewhat in 2017 and 2018. Germany has also clearly missed its climate targets. In order to keep global warming below 2 °C, only about 1100 gigatonnes of CO2 may be released into the atmosphere by 2050. And In order to limit global warming to 1.5°, only just under 400 gigatonnes of CO2 may be emitted worldwide. By 2050, emissions will have to fall to zero even. Currently, however, 42 gigatonnes of CO2 are added every year. Almost all the various scenarios require "negative emissions"

The Intergovernmental Panel on Climate Change (IPCC) has numerically simulated various scenarios. Only in the most optimistic scenario can the climate target still be achieved by means of immediate and drastic measures in all sectors (transport, agriculture, construction, energy, etc.). In the less optimistic scenarios, the global community will have to take additional measures beginning in 2030 or by 2050 at the latest: we will have to implement "negative emissions" by removing large quantities of CO_2 from the atmosphere and store them permanently in order to balance the carbon budget. One example of negative emissions is large-scale forestation—forests bind CO_2 in wood as long as it is not later used as fuel. But CO_2 could also be removed from the atmosphere and bound using artificial photosynthesis.

Physicists have now calculated how this might work. Dr Matthias May of the HZB Institute for Solar Fuels is an expert in artificial photosynthesis. Dr Kira Rehfeld is an environmental physicist at the University of Heidelberg studying climate and environmental variability.

Natural photosynthesis: a surface area the size of Europe would have to be forested.

In a median scenario, at least 10 gigatonnes of CO_2 per year would have to be removed from the atmosphere beginning around 2050 to balance the climate carbon budget. Forestation and cultivation of biomass for reducing CO_2 compete for the same areas as are needed for agriculture, however. With just more biomass alone, it is therefore difficult to reach this scale, for natural photosynthesis is not a particularly efficient process. Leaves are able to use a maximum of two per cent of the light for converting CO_2 and water into new chemical compounds. The two physicists argue that in order to bind 10 gigatonnes of CO_2 per year in the forest, about 10 million square kilometres of the fertile areas on Earth would have to be planted with new forest. This corresponds to the area of continental Europe (up to the Urals!).

With artificial photosynthesis, an area the size of the State of Brandenburg could suffice

Materials systems currently being researched for artificial photosynthesis might bind CO_2 with considerably greater efficiency. Already today, on a lab scale, photo-electrochemical systems made of semiconductor materials and oxides can utilise about nineteen per cent of the light to split water, for example, and thus realize part of the

photosynthesis process. However, the material system envisaged by May and Rehfeld is not about producing hydrogen with sunlight, but instead about binding CO_2 molecules and converting them into stable chemical compounds. "However, this is a relatively similar problem from the point of view of physical chemistry," says May.

The prerequisite, however, is that it will be possible to develop by 2050 large-scale, durable modules that use solar energy to convert atmospheric CO_2 into other compounds. The required area for this solution can be calculated. Assuming efficiency of nineteen per cent and fifty per cent system losses, around 30,000 square-kilometres of modules could be sufficient to extract 10 gigatonnes of CO_2 from the atmosphere annually. This corresponds to the approximate area of the German federal State of Brandenburg.

"These kinds of modules could be placed in non-agricultural regions -- in deserts, for example. In contrast to plants, they require hardly any water to operate, and their efficiency does not suffer when exposed to intense solar radiation," explains May. The extracted CO_2 could be converted to formic acid, alcohol or oxalate and combined with other compounds (such as calcium chloride) to form solid minerals that can be stored or even used in the form of plastic as a building material.

Focus on development, not on miracles

Even if May and Rehfeld are convinced that such solutions should be considered more closely, they warn against relying on technical miracles. This is because such systems still only function at the smallest scale, are expensive, and not stable in the long term. Changing this requires large investments in research and development.

"It might be possible to develop such modules, but even if we could then build them, we estimate that the conversion will cost at least 65 euros per tonne of CO_2. The extraction of 10 gigatonnes of CO_2 thus results in costs of 650 billion euros each year. Moreover, negative emissions can only be the last resort to slow dramatic climate developments. The best thing now would be to drastically reduce emissions immediately -- that would be safer and much cheaper," says May.

https://www.sciencedaily.com/releases/2019/01/190116111011.htm

Discovery adapts natural membrane to make hydrogen fuel from water

A chemical reaction pathway central to plant biology have been adapted to form the backbone of a new process that converts water into hydrogen fuel using energy from the sun.

In a recent study from the U.S. Department of Energy's (DOE) Argonne National Laboratory, scientists have

combined two membrane-bound protein complexes to perform a complete conversion of water molecules to hydrogen and oxygen.

The work builds on an earlier study that examined one of these protein complexes, called Photosystem I, a membrane protein that can use energy from light to feed electrons to an inorganic catalyst that makes hydrogen. This part of the reaction, however, represents only half of the overall process needed for hydrogen generation.

By using a second protein complex that uses energy from light to split water and take electrons from it, called Photosystem II, Argonne chemist Lisa Utschig and her colleagues were able to take electrons from water and feed them to Photosystem I.

"The beauty of this design is in its simplicity -- you can self-assemble the catalyst with the natural membrane to do the chemistry you want," said Lisa Utschig, an Argonne chemist.

In an earlier experiment, the researchers provided Photosystem I with electrons from a sacrificial electron donor. "The trick was how to get two electrons to the catalyst in fast succession," Utschig said.

The two protein complexes are embedded in thylakoid membranes, like those found inside the oxygen-creating chloroplasts in higher plants. "The membrane, which we have taken directly from nature, is essential for pairing the two photosystems," Utschig said. "It structurally supports both of them simultaneously and provides a direct pathway for inter-protein electron transfer, but doesn't impede catalyst binding to Photosystem I."

According to Utschig, the Z-scheme -- which is the technical name for the light-triggered electron transport chain of natural photosynthesis that occurs in the thylakoid membrane -- and the synthetic catalyst come together quite elegantly. "The beauty of this design is in its simplicity -- you can self-assemble the catalyst with the natural membrane to do the chemistry you want," she said.

One additional improvement involved the substitution of cobalt or nickel-containing catalysts for the expensive platinum catalyst that had been used in the earlier study. The new cobalt or nickel catalysts could dramatically reduce potential costs.

The next step for the research, according to Utschig, involves incorporating the membrane-bound Z-scheme into a living system. "Once we have an in vivo system -- one in which the process is happening in a living organism -- we will really be able to see the rubber hitting the road in terms of hydrogen production," she said.

https://www.sciencedaily.com/releases/2019/01/190110164657.htm

Seawater turns into freshwater through solar energy: A new low-cost technology

According to FAO estimates, by 2025 nearly 2 billion people may not have enough drinking water to satisfy their daily needs. One of the possible solutions to this problem is desalination, namely treating seawater to make it drinkable. However, removing salt from seawater requires 10 to 1000 times more energy than traditional methods of freshwater supply, namely pumping water from rivers or wells.

Motivated by this problem, a team of engineers from the Department of Energy of Politecnico di Torino has devised a new prototype to desalinate seawater in a sustainable and low-cost way, using solar energy more efficiently. Compared to previous solutions, the developed technology is in fact able to double the amount of water produced at given solar

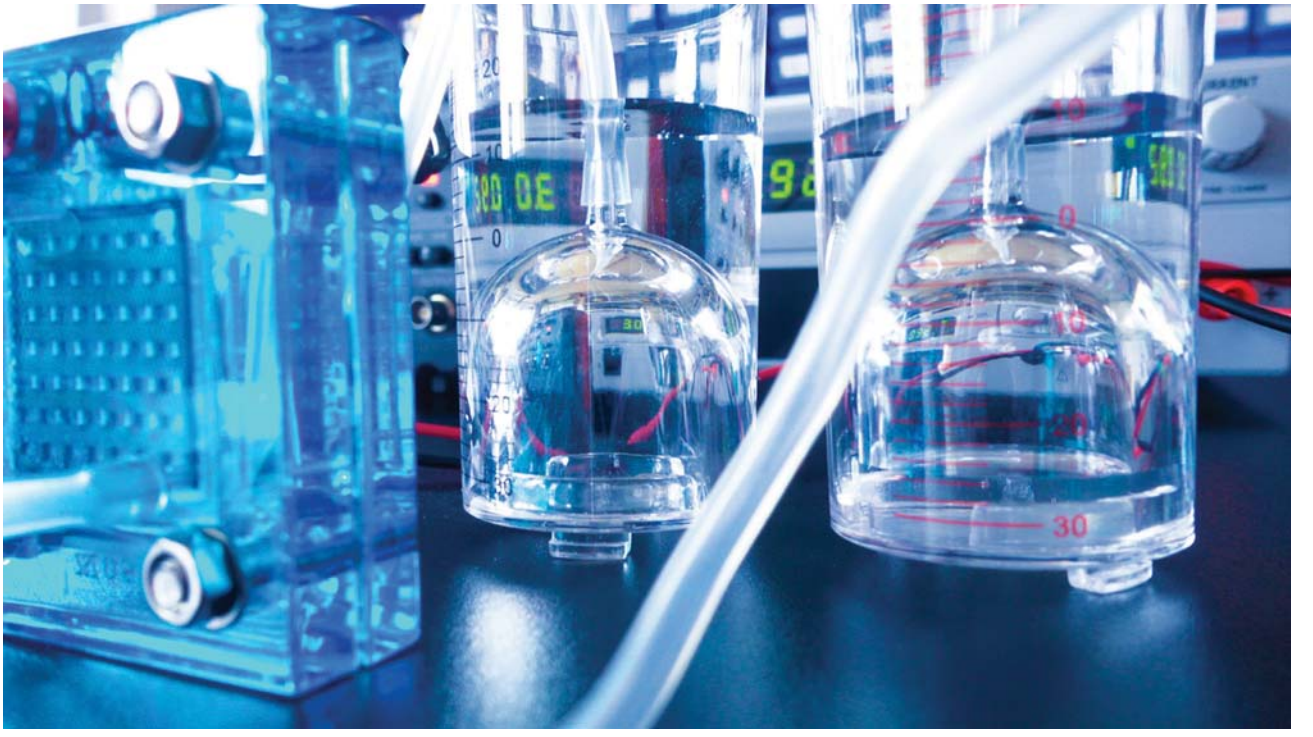
energy, and it may be subject to further efficiency improvement in the near future. The group of young researchers who recently published these results in the journal Nature Sustainability is composed of Eliodoro Chiavazzo, Matteo Morciano, Francesca Viglino, Matteo Fasano and Pietro Asinari (Multi-Scale Modeling Lab).

The working principle of the proposed technology is very simple: "Inspired by plants, which transport water from roots to leaves by capillarity and transpiration, our floating device is able to collect seawater using a low-cost porous material, thus avoiding the use of expensive and cumbersome pumps. The collected seawater is then heated up by solar energy, which sustains the separation of salt from the evaporating water. This process can be facilitated by membranes inserted between contaminated and drinking water to avoid their mixing, similarly to some plants able to survive in marine environments (for example the mangroves)," explain Matteo Fasano and Matteo Morciano.

While conventional 'active' desalination technologies need costly mechanical or electrical components (such as pumps and/or control systems) and require specialized technicians for installation and maintenance, the desalination approach proposed by the team at Politecnico di Torino is based on spontaneous processes occurring without the aid of ancillary machinery and can, therefore, be referred to as 'passive' technology. All this makes the device inherently inexpensive and simple to install and repair. The latter features are particularly attractive in coastal regions that are suffering from a chronic shortage of drinking water and are not yet reached by centralized infrastructures and investments.

Up to now, a well-known disadvantage of 'passive' technologies for desalination has been the low energy efficiency as compared to 'active' ones. Researchers at Politecnico di Torino have faced this obstacle with creativity: "While previous studies focused on how to maximize the solar energy absorption, we have shifted the attention to a more efficient management of the absorbed solar thermal energy. In this way, we have been able to reach record values of productivity up to 20 litres per day of drinking water per square meter exposed to the Sun. The reason behind the performance increase is the 'recycling' of solar heat in several cascade evaporation processes, in line with the philosophy of 'doing more, with less'. Technologies based on this process are typically called 'multi-effect', and here we provide the first evidence that this strategy can be very effective for 'passive' desalination technologies as well."

After developing the prototype for more than two years and testing it directly in the Ligurian sea (Varazze, Italy), the Politecnico's engineers claim that this technology could have an impact in isolated coastal locations with little drinking water but abundant solar energy, especially in developing countries. Furthermore, the technology is particularly suitable for providing safe and low-cost drinking water in emergency conditions, for example in areas hit by floods or tsunamis



and left isolated for days or weeks from electricity grid and aqueduct. A further application envisioned for this technology are floating gardens for food production, an interesting option especially in overpopulated areas. The researchers, who continue to work on this issue within the Clean Water Center at Politecnico di Torino, are now looking for possible industrial partners to make the prototype more durable, scalable and versatile. For example, engineered versions of the device could be employed in coastal areas where over-exploitation of groundwater causes the intrusion of saline water into freshwater aquifers (a particularly serious problem in some areas of Southern Italy), or could treat waters polluted by industrial or mining plants.

https://www.sciencedaily.com/releases/2019/01/190107131242.htm

Low-cost catalyst boosts hydrogen production from water

A future powered by carbon-free fuel depends on our ability to harness and store energy from renewable but intermittent sources, such as solar and wind. Now, a new catalyst developed at University of Toronto Engineering gives a boost to a number of clean energy technologies that depend on producing hydrogen from water.

In addition to being a key ingredient in everything from fuel to fertilizers, hydrogen has great potential as an energy storage medium. The idea would be to use renewable electricity to produce hydrogen from water, then later reverse the process in an electrochemical fuel cell, resulting in clean power on demand.

"Hydrogen is a hugely important industrial feedstock, but unfortunately today it is derived overwhelmingly from fossil fuels, resulting in a large carbon footprint," says Professor Ted Sargent, senior author on a paper in Nature Energy that describes the new catalyst. "Electrolysis -- water splitting to produce renewable hydrogen and oxygen -- is a compelling technology, but it needs further improvements in efficiency, cost, and longevity. This work offers a fresh strategy to pursue these critically important aims."

Sargent's lab is among several research groups around the world racing to create catalysts that lower the amount of electricity needed to split water into hydrogen and oxygen. Currently, the best-performing catalysts rely on platinum, a high-cost material, and operate under acidic conditions.

"Our new catalyst is made from copper, nickel and chromium, which are all more abundant and less costly than platinum," says Cao-Thang Dinh, a co-lead author on the paper along with his fellow postdoctoral researchers Pelayo Garcia De Arquer and Ankit Jain. "But what's most exciting is that it performs well under pH-neutral conditions, which opens up a number of possibilities."

Seawater is the most abundant source of water on earth, Dinh points out. But using seawater with traditional catalysts under acidic conditions would require the salt to be removed first, an energy-intensive process. Operating at neutral pH avoids the high cost of desalination.

It could also enable the use of microorganisms to make chemicals such as methanol and ethanol. "There

are bacteria that can combine hydrogen and CO2 to make hydrocarbon fuels," says Garcia De Arquer. "They could grow in the same water and take up the hydrogen as it's being made, but they cannot survive under acidic conditions."

Using renewable energy to convert waste CO2 into fuels or other value-added products is the goal of the NRG COSIA Carbon XPrize. A team from Sargent's lab is among the five finalists in the international competition, vying for the US $7.5-million grand prize.

https://www.sciencedaily.com/releases/2018/12/181212121845.htm

New catalyst produces cheap hydrogen fuel

Professor Anthony O'Mullane said the potential for the chemical storage of renewable energy in the form of hydrogen was being investigated around the world.

"The Australian Government is interested in developing a hydrogen export industry to export our abundant renewable energy," said Professor O'Mullane from QUT's Science and Engineering Faculty.

"In principle, hydrogen offers a way to store clean energy at a scale that is required to make the rollout of large-scale solar and wind farms as well as the export of green energy viable. "However, current methods that use carbon sources to produce hydrogen emit carbon dioxide, a greenhouse gas that mitigates the benefits of using renewable energy from the sun and wind.

"Electrochemical water splitting driven by electricity sourced from renewable energy technology has been identified as one of the most sustainable methods of producing high-purity hydrogen."

Professor O'Mullane said the new composite material he and PhD student Ummul Sultana had developed enabled electrochemical water splitting into hydrogen and oxygen using cheap and readily available elements as catalysts.

"Traditionally, catalysts for splitting water involve expensive precious metals such as iridium oxide, ruthenium oxide and platinum," he said.

"An additional problem has been stability, especially for the oxygen evolution part of the process.

"What we have found is that we can use two earth-abundant cheaper alternatives -- cobalt and nickel oxide with only a fraction of gold nanoparticles -- to create a stable bi-functional catalyst to split water and produce hydrogen without emissions.

"From an industry point of view, it makes a lot of sense to use one catalyst material instead of two different catalysts to produce hydrogen from water."

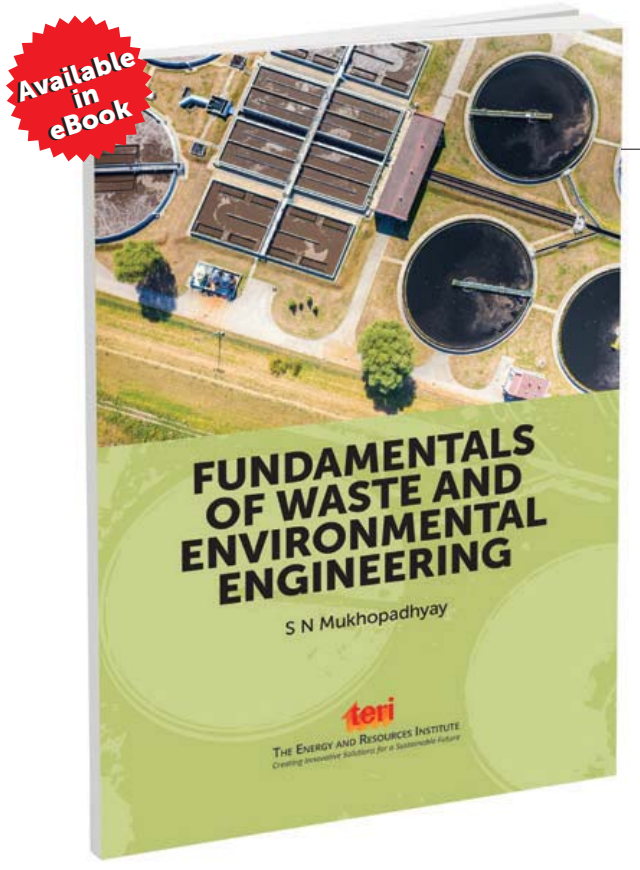
Professor O'Mullane said the stored hydrogen could then be used in fuel cells.

"Fuel cells are a mature technology, already being rolled out in many makes of vehicle. They use hydrogen and oxygen as fuels to generate electricity -- essentially the opposite of water splitting.

"With a lot of cheaply 'made' hydrogen we can feed fuel cell-generated electricity back into the grid when required during peak demand or power our transportation system and the only thing emitted is water." EF

https://www.sciencedaily.com/releases/2018/11/181129100036.htm

ENVIRONMENTAL REMEDIATION THROUGH ENVIRONMENTAL ENGINEERING



Major topics covered

- Air Pollution and Its Abatement
- Wastes to Value-added Products
- Water, Wastewater, and Non-aqueous Liquids
- Waste Heat Treatments and Utilizations
- Solid/semisolid Waste Treatments/ Management for Business Developments
- Environmental Variance and Effects of Pollution on Humans.

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2nd Global RE-INVEST 2018
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Website: https://re-invest.in/

Solar Roofs Karnataka 2018
Bengaluru, Karnataka
October 12, 2018
Website: https://solarquarter.com/solarroofs/index.php/past-edition/conference/solarroofs-karnataka-2018

EV India Charging Conclave 2018
October 25–26, 2018
New Delhi, India
Website: https://www.evindiacharging.com/1

REIFF - Renewable Energy Investment & Finance Forum 2018
November 2, 2018
Mumbai, India
Website: https://www.tradeindia.com/TradeShows/72312/REIFF-Renewable-Energy-Investment-Finance-Forum.html

Green Power 2018
December 4–5, 2018
Chennai, India
Website: http://www.greenpower-cii.com/

Intersolar India West
April 4–5, 2019
Mumbai, India
Website: https://www.intersolar.in/en/home.html

Electric, Hybrid, Solar Vehicle & Eco Green: EHSE 2019
April 20–21, 2019
Bengaluru, India
Website: https://www.energysector.in/events/electric-hybrid-solar-vehicle-eco-green-ehse

INTERNATIONAL

Maryland Clean Energy Summit
October 8–10, 2018
Maryland, USA
Website: https://mcecsummit.org/

BioCycle Conference On Renewable Energy From Organics Recycling (BioCycle Refor)
October 16–17, 2018
North Carolina, USA
Website: http://biocyclerefor.com/

4th International Conference on Renewable, Conventional Power and Green Technology 2018
October 22, 2018
London, United Kingdom
Website: https://www.eventbrite.co.uk

Future of Biogas Europe
November 7¬–8, 2018
London, United Kingdom
Website: https://www.eco-business.com/events/future-of-biogas-europe/

Solar & Off-Grid Renewables Southeast Asia
November 26–27, 2018
Nonthaburi, Thailand
Website: https://seasia.solarenergyevents.com/

Berlin Energy Transition Dialogue 2019
April 9–10, 2019
Berlin, Germany
Website: https://2019.energydialogue.berlin/

AWEA WindPower
May 20–23, 2019
Houston, USA
Website: https://www.windpowerexpo.org/

RENEWABLE ENERGY AT A GLANCE

Ministry of New & Renewable Energy			
Programme/Scheme wise Physical Progress in 2019-20 & Cumulative upto April, 2019			
Sector	**FY- 2018-19**		**Cumulative Achievement (April-July 2018) (as on 30.04.2019)**
	Target	**Achievement (April 2019)**	
I. GRID-INTERACTIVE POWER (CAPACITIES IN MW)			
Wind Power	3000.00	189.92	35815.88
Solar Power - Ground Mounted	7500.00	445.55	26829.87
Solar Power - Roof Top	1000.00	52.95	1849.34
Small Hydro Power	50.00	1.00	4594.15
Biomass (Bagasse) Cogeneration	150.00	28.00	9131.50
Biomass (non-bagasse) Cogeneration/Captive Power	100.00	0.00	674.81
Waste to Power	2.00	0.00	138.30
Total	11802.00	717.42	79033.85
I. OFF-GRID/ CAPTIVE POWER (CAPACITIES IN MWEQ)			
Waste to Energy	10.00	0.00	178.73
Biomass Gasifiers	1.00	0.00	163.37
SPV Systems	400.00	0.73	916.34
Total	411.00	0.73	1258.44
III. OTHER RENEWABLE ENERGY SYSTEMS			
Biogass Plants	86900.00	0.00	25561.00

State wise installed capacity of grid Interactive Renewable power as on(Posted on 20.05.2019)

Source: www.mnre.gov.in

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