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SET 2019, 20 - 22 August 2019
Kuala Lumpur, Malaysia

Call for Papers

SET2019, the 18th International Conference on Sustainable Energy Technologies, will be held in Kuala Lumpur, Malaysia, on 20th to 22nd August 2019. The conference will be hosted by Universiti Sains Malaysia and will be held in a convention centre close to 4/5 star hotels, malls, restaurants, and bars.

Kuala Lumpur (KL) is the capital of Malaysia and is one of the fastest growing metropolitan regions in South-East Asia in both population and economic development. It has many interesting attractions such as Petronas Twin Towers, Merdeka Square, Chinatown, KL Tower and much more.

Topic areas for SET2019 cover Energy Technologies and Renewables; Energy Storage and Conversion; Low Carbon Buildings and Sustainable Cities; and Policies and Management. Go to www.set2019.org/topics for more information. Selected papers will be published in a number of international journals.

Papers should be submitted via EasyChair - a link can be found on the SET2019 website: www.set2019.org/submission-registration/submissions-2/

You could also submit your research projects to the 4th WSSET Innovation Awards (please see www.wsset.org/innovation-award-2019). Winners will be announced at the SET2019 Conference gala dinner.

All WSSET members will receive a 20% discount on the conference registration fees. Postgraduate students can also apply for a conference registration grant which will be awarded to up to 4 students. More information can be found here: www.set2019.org/submission-registration/student-travel-grant/

Deadline Date Action
30th April 2019 One Page Abstract Submission / Abstract Registration Deadline
15th May 2019 Notification of Abstract Acceptance
7th June 2019 Full Manuscript Submission
1st June 2019 Deadline for Student Registration Grant Application
30th June 2019 Notification of Manuscript Acceptance & of Scholarship Award
17th July 2019 Submission of Revised Accepted Papers
TESSe²b - Thermal Energy Storage Systems for Energy Efficient Buildings
Zafer URE, Adam Dicken*, Sam Gledhill, Luis Coelho

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Buildings are responsible for 40% of primary energy consumption and 36% of CO₂ emissions in the EU. Nowadays, there is a need for encouraging energy efficiency in buildings; enhancing green technologies and promoting advance thermal energy storage solutions to reduce energy consumption and emissions.

TESSe²b is an integrated solution for residential building energy storage by solar and geothermal resources. The main goal of the project is to design, develop, validate and demonstrate a modular and low cost thermal storage technology based on solar collectors and highly efficient geothermal heat pumps for heating, cooling and domestic hot water production for residential buildings. The design will be demonstrated at three pilot sites in Austria, Spain and Cyprus, offering a variety of climates representative of those across the continent.

![Spain and Austria](image)

**Figure 1: Demo site locations**

By combining solar collectors; geothermal heat pumps; enhanced geothermal boreholes; and latent heat thermal energy storage (TES) with an intelligent, self-learning controls system, the energy performance of a resident building can be greatly improved.

The solar thermal energy produces domestic hot water and supplies the house heating demand. A geothermal heat pump will provide space cooling but, during days where solar thermal energy is limited, it will also supply space heating.

![Diagram of TESSe²b Concept](image)

**Figure 2: TESSe²b Concept**

The main innovation of this project is the use of latent heat thermal energy storage batteries. This allows the use of renewable energy to be optimised, often, there is a mismatch between the between the energy supply and demand in residential buildings. By correcting this mismatch using an intelligent control system, energy can be used at the correct time and any excess can be stored for future usage. Benefits of this include; decreased operating costs, help balance electrical grid demands; and shifting heat pump operation into low electric tariff periods.

The key advantage of using latent thermal energy storage instead of conventional sensible heat storage is superior storage density without ever increasing heat losses and the ability to store heat at a constant and well-defined temperature. It is anticipated that TESSe²b will reduce the building energy consumption by at least 15%; however early results indicate that it might be as high as 25-30%, with a corresponding reduction in operating costs. The payback period is expected to be between 8-9 years.

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under project No 680555.
Floating Deep Farms That Can Solve Food Production against Sea Level Rise

Saffa Riffat, Yijun Yuan
Dept of Architecture & the Built Environment, University of Nottingham

University of Nottingham academics Professors Saffa Riffat (President of the World Society of Sustainable Technologies and Fellow of the European Academy of Sciences) and Yijun Yuan (EU Marie Curie Fellow) have come up with breakthrough/patented technologies to allow intensive food production in seas, coastal areas and rivers.

Feeding the projected 2050 world population of about 9 billion people in will require global food production to be increased by some 70% between now and then. But current land-based systems for food production cannot meet this extra demand. The problem is exacerbated by rising sea levels caused by climate change. Land area reduction due to inundation and coastal erosion will have a major impact on the availability of agriculture land for food production with small islands being especially vulnerable.

To use less land, farms could be spread vertically rather than horizontally. This ‘Vertical Farms’ approach uses multi-layer greenhouses or skyscraper towers to intensify food production. With a controlled climate involving LED lighting and a closely monitored water/nutrient supply, these farms can produce multiple crops and high yields. But there is an option.

Marine agriculture has already been explored to ensure future food security. Ocean Reef Group, USA, proposed growing plants in pods (biospheres, each of which can hold around 22 plant pots) on the seabed. The project is interesting but is not viable for a large scale food production.

Fisherman Bren Smith has developed a vertical ocean farm which uses a water column to grow a variety of species such as sugar kelp, oysters, mussels and scallops. Indeed, some countries (e.g. China and Thailand) have been practicing aquaculture for many years. In the UK, salmon from fish farms is already a staple of our diet. In fact, recently aquaculture surpassed wild fishing as the primary source of protein from the ocean. However, these types of farms are not suitable for crop production. Farmers in Bangladesh survive the monsoon using an ancient technique of building floating farms that rise and fall with swarming waters.

Turning to the seas could be one solution for crop production to ensure the human population is adequately fed in the coming decades. A breakthrough has been made by University of Nottingham academics Professors Saffa Riffat and Yijun Yuan who have filed 5 patent applications in November and December 2018 claiming novel cultivation technology based on using Deep Farms in land, seawater and rivers.

Professor Riffat says ‘We really have new breakthrough technologies in food production in land and sea’.

Floating Deep Farms use large vertical shafts submerged in sea water near coastal areas. The shaft is sealed at the bottom end and is covered by a dome as illustrated in Figure 1 below. A variety of crops can be grown using hydroponic planters (plant roots fed with nutrient-rich water) or aeroponics (growing plants in an air or mist environment). LED units providing illumination at appropriate wavelengths to maximise photosynthesis with minimum power input replacing sunlight.

A major benefit is that crop production is largely unaffected by climatic or seasonal factors - one of the greatest limitations of conventional farming methods.

Furthermore, enclosed Floating Deep Farms allow plants diseases and pests to be readily controlled with little or no application of chemical biocides.

The engineering knowhow to build marine vertical shafts is already available from the off-shore oil/gas and wind energy industries. Indeed, Floating Deep Farms could be integrated with wind turbines to power the LED lighting and other systems necessary for crop production. Such installations would not be subject to seasonal light variation, continuing in production throughout the year. Unlike present off-shore “wind farms” supplying renewable energy, Floating Deep Farms could be sited in deep water far from the coast since their locations would not be limited by power cables. Crops could be delivered to land by electrically powered ships charged by wind energy. It is also tempting to suggest that Floating Deep Farm installations might also have a secondary function of capturing discarded plastic.

Tide and wave energy could also be used for powering Floating Deep Farms although these would be inshore. Tidal power might be preferable to PV, especially as this is available day and night. Would integrated Deep Farms change the economics of barrages such as those proposed for the Severn Estuary?

Cont.
In coastal areas, Floating Deep Farms could even be combined with towers used for housing or offices. About 70% of the earth is covered with seawater. The fresh water required by the Floating Deep Farm can be created through a simple seawater evaporation desalination unit driven by a combination of solar energy and waste heat from LED lights, as in figure 2. It is anticipated that much of the fresh water will be recycled, so, after initial charging, only a limited quantity of “make-up” water will be required. The quantity of water required will be reduced by 80% compared to conventional land-based agriculture.

Unlike conventional greenhouses and vertical farms which rely heavily on heating and cooling systems to regulate the temperature, the submergence of the Deep Farm into seawater offers a stable temperature throughout the year. The diurnal fluctuations in solar radiation and temperature that limits the productivity of many plants will be eliminated by the closed environment of Floating Deep Farms.

For coastal installations, various aesthetic design approaches could be used to make Floating Deep Farms blend with the surrounding environment and also to avoid any impact on communities which often rely on fish for food and as a source of income. The Floating Deep Farm can also be designed to incorporate an aquaculture for fish and other species (e.g., scallops and mussels) as shown in figure 3. This will allow oxygen generated by plants to be fed directly into the fish section of Floating Deep Farms. Structures would need to withstand extreme weather but offshore wind turbine technology has already addressed these problems.

Eighteen of the world’s megacities (population of about 350 million) which are located along the coastal areas could use Floating Deep Farms to supply fresh crops instead of using frozen food transported by refrigerated trailers. This will help to reduce expensive carbon miles caused by mass food importation and therefore minimise the world’s overall carbon footprint.

‘Floating Deep Farms would address food shortage in developing and third world countries with coastal areas’

Floating Deep Farms will allow crop production all year-round. Up to 10 crop cycles per year can be achieved compared to 1-2 cycles for conventional agriculture. One small Deep Farm can produce around 80 tonnes of food per annum and crops can be ready for harvesting within 3-4 weeks of propagation. Floating Deep Farms will have lower energy requirements than traditional vertical farms. A single Deep Farm will have about the same consumption as three UK homes using innovative LEDillumination and controls combined with natural lighting using light rods or optical fibres. The carbon dioxide demand of photosynthesising plants can be captured from ambient air using materials such as activated carbon (Figure 2).

Floating Deep Farms can be used to grow a range of vegetable and herb crops including lettuce, kale, spinach, basil, carrots, onions, cucumbers, and different types of mushrooms. For crop planting and harvesting, a simple belt (or basket) and pulley arrangement could be used to carry plants to the top of the Floating Deep Farm avoiding the requirement of manual work in the shaft. Robots may also be employed.

Professor Riffat says ‘We have come up with solutions to address food production in countries which are vulnerable to sea level rise caused by climate change’

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The innovative Aerogel Phenolic Foam Board

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Nowadays, applying a thermal barrier coating on the outer surfaces of the building envelope is a common solution to enhance the heat insulation performance of buildings. With this method, airborne particles deposited on the roof surface and weather-proof performance of the coating are the key parameters that affect the heat insulation performance of a building. Alternatively, thermal insulation materials can be installed in roofs or exterior walls. Common thermal insulation materials are PU/PS foam board or mineral wool board. Although PU foam board is an effective thermal insulation material, it is highly combustible. While mineral wool is a flame retardant material, the thermal conductivity of mineral wool board is much higher than that of foam board. Phenolic foam is considered to be one of the best materials for thermal insulation. It has low thermal conductivity, fire retardant properties and a low smoke level (even under pyrolysis). However, commercially available phenolic foam boards with flame retardants in it are mostly classified as "non-flammable level II" or "non-flammable level III".

The innovative aerogel phenolic foam board (APFB) was developed for effective thermal insulation and fire protection and it consists of a phenolic foam board integrated with a 3 wt% aerogel particles with an aluminium foil layer on top of the foam board as illustrated in Figure 1. The aluminium foil layer has a surface emissivity of 0.901, a visible light reflectance of 75.59, a solar reflectance of 78.47, and an ultraviolet reflectance of 72.40, so it could block the thermal radiation and decrease the surface temperature of APFB.

Aerogel is regarded as one of the most promising high performance thermal insulation material today, but only limited commercial products are available due to its cost and reliability. In this invention, spherical silica aerogel is produced under ambient pressure drying without complicated surface modification and solvent exchange process. Furthermore, the effect of adding aerogel for enhancing thermal conductivity and thermal stability of APFB is obvious. Phenolic foam board with the addition of small particles has better thermal insulation than that with large particles. This is because the large particles increase thermal conductivity for two reasons. One is that large particles can hinder phenolic resin from foaming, and form cracks in the phenolic foam board which affect the integrity of the pores. The other reason is that it is more difficult for large particles to disperse, and thus the aerogels are not uniformly distributed in the whole phenolic foam board. The thermal stability of the phenolic foam board was proved to be affected by both aerogel filler particle size and density. Large aerogel particles decrease the thermal stability of the APFB while high aerogel density increase thermal stability.

The fire resistance performance of APFB tested by a cone calorimeter indicates that the density of aerogel and release agent are two key parameters that affect the fire resistance of APFB. High aerogel density will affect the structural integrity of APFB, and cause it to break. Aerogel's pore coated with phenolic resin caused heat accumulation during the testing. The release agent increased both the heat release rate and total heat release after being heated and also caused water vapour to break the structure of APFB during testing due to the internal pressure of the specimens. According to the information provided above, the optimal content of aerogel filler for achieving the non-flammable level 1 and lowest thermal conductivity of APFB is 3 wt%.

Figure 1: The schematic diagram of Aerogel Phenolic Foam Board

Figure 2: Fire-resistance testing of Aerogel Phenolic Foam Board
Low carbon prefabricated homes for low income families of Chinese Villages

Shihao Zhang, Qi Xu, Hasila Jarimi and Saffa Riffat

Department of Architecture & the Built Environment, University of Nottingham

The University of Nottingham is working with Hubei University of Technology (HBUT) in Wuhan, China, to design a low carbon prefabricated house aimed to address challenges facing the construction industry to produce housing that is both fast to build, but also affordable and highly energy efficient.

Built on the HBUT campus, the house incorporates various innovations with degrees of flexibility to allow the testing of different aspects of prefabricated construction and sustainable technologies. This innovative house is an answer to the call of the Chinese government to wide scale applications of prefabricated low carbon homes.

The low carbon house uses several novel technologies developed under innovate UK funding including:

**Innovative window heat recovery:** Small heat recovery units using heat pipes and air filters are installed in the window frames. The window heat recovery unit can recover about 70% of the heat needed to make outdoor air comfortable when it is supplied to the room.

**Thermal energy storage:** Phase change materials (PCMs) melt and freeze at a constant temperature and absorb or release latent heat during this process. Innovative phase change material panels are used to enhance building thermal mass and also reduce room overheating in the summer.

**Innovative PV vacuum glazing:** A high performance PV vacuum glass windows with a U-value of about 0.6 W/m²K is used in the house. The windows reduce the heat loss during the winter by about 75%. The windows also generate electricity for the house.

Other sustainable technologies used include rainwater harvesting and recycling systems, and natural coating materials are employed for the envelope of the prefabricated modules using standard manufacturing processes. The house uses environmentally friendly materials that are of biological and recycled origins and contain significantly reduced cement content. The project aims to prove to the Chinese local governments that £30k low carbon houses can be built using prefabricated construction methods. Carbon emissions are reduced by about 100% compared to current building regulations in China.

The key feature of this low carbon house is its flexibility to allow testing of different aspects of building construction and sustainable technologies in order to identify the most cost effective and environmentally sound solutions. It also demonstrates a range of new construction methods and energy efficient systems. Designed to reduce primary energy demand, it is constructed using a light weight steel frame system and is designed for low income families for Chinese villages.

The conceptual design of the low carbon home has been carried out by staff and students of the Department of Architecture and Built Environment, University of Nottingham. The Department benefited greatly from the strong links with industry and academic institutions in China. The low carbon house has been used for R&D projects and training of both British and Chinese students. The benefits to industry include evaluation of the performance of new products, showcase for new technologies and knowledge/technology transfer.

Work on the low carbon house project has led to significant research outputs, for example, the house relies on passive design features, construction materials and techniques appropriate for the latitude and low to zero carbon technologies. The house is projected to achieve the Passive House certification criteria standards Part 1 of a total energy demand for space heating and cooling less than 15 kWh/m² per year treated floor area and for the primary energy to be less than 120 kWh/m² per year. These targets have been met successfully.

The authors would like to thank Innovate UK and Hubei University of Technology for funding the project.
The University of Nottingham wins award at Rushlight Event, 2019.

Led by Professor Saffa Riffat, the project aims to design and manufacture a highly innovative thin film photovoltaic-vacuum glazing (PV-VG) for building applications. The project won the Rushlight Responsible Product or Service Award.

Setting it apart from the conventional double and triple glazing, at thickness between 10-14 mm, the innovative PV-VG is not only light in weight, it can generate solar power and 50-60% lower in thermal conductivity.

The use of PV-VG would provide an excellent solution for control of solar gain making it ideal for application in both hot and cold climates. The PV-VG is expected to reduce energy loss through building fabric by about 20% and therefore would assist in achieving the UK and China’s Government targets to minimize energy consumption and CO2 emissions.

Thin film PV-VG is a Newton Fund joint research and commercialization project between UK consortiums (University of Nottingham, Vale Window Company Ltd, Geo Green Power Ltd and Solar Ready Ltd) and China consortiums (Hubei University of Technology and Hanergy Holding Group Ltd). It is funded by Innovate UK (UK) and MOST (China).

Another University of Nottingham project received a commendation: Low carbon prefabricated homes for low income families of Chinese Villages. This project incorporates the PV-VG and you can find more information on this exciting work in the article on page 6 of this newsletter.

The Rushlight Awards is an annual event focusing on celebrating and promoting cleantech innovation which combines all the latest and best in energy, cleantech and sustainability.

4th WSSET Innovation Awards 2019

The WSSET Innovation Awards recognise the achievements of private individuals and organisations in new sustainable technologies and encourage the wider application of these new developments. Funding of £1000 is available to help get a concept or research idea to market. If you have a good idea, we can help match you to an organisation.

Submit your entries by visiting www.wsset.org/innovation-award-2019/ to download an entry form. Deadline: 30th March 2019

Winners will be announced at SET 2019 in Kuala Lumpur, Malaysia
**WSSET exclusive offer – IJLCT**

The International Journal of Low-Carbon Technologies (IJLCT), which recently received an inaugural Impact Factor of 0.837 with indexing in the WOS and the JCR, offers a 25% discount to the APC (article processing charge) for WSSET members wishing to publish a paper in IJLCT (open access). This will cost WSSET members £638 as opposed to the full charge of £850. Authors will need to state that they are WSSET members when paying.

Please visit [www.ijlct.oxfordjournals.org](http://www.ijlct.oxfordjournals.org) to submit your articles.

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**WSSET exclusive offer - FCaE**

Also in conjunction with Future Cities and Environment (FCaE), WSSET have agreed a £25 discount to the APC (article processing charge) for WSSET members wishing to publish a paper in FCaE (open access). This will cost WSSET members £475 compared to the full charge of £500. Authors will need to declare their membership details to the editorial team when it comes to payment before publication.

Please visit [www.futurecitiesandenvironment.com](http://www.futurecitiesandenvironment.com) to submit your articles.

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Renewable Bioresources is an Open Access (Gold OA), peer reviewed, international online publishing journal, which aims to publish premier papers on all the related areas of advanced research carried in its field. Renewable Bioresources emphasizes the advanced applications of biotechnology to improve biological ecosystems through renewable energy derived from biological sources.

Please visit [www.hoajonline.com/renewablebioresources](http://www.hoajonline.com/renewablebioresources) to submit your articles.
All WSSET members are kindly invited to submit articles for publication in future WSSET newsletters. Articles can be on a range of topics surrounding the word of sustainable energy technologies. With nearly 2000 members, the WSSET newsletter provides a great opportunity to publicise new ideas, technologies or products — all free of charge!

Articles should be no more than 400-500 words and one or two photographs would be very much appreciated. Submissions should be emailed to secretary@wsset.org

Furthermore please contact secretary@wsset.org regarding any conferences, seminars or symposiums relating to topics of sustainable energy technologies that you wish to be advertised in the newsletter.

Once again, thank you for your continued support to WSSET.