Renewable energy and water sustainability: lessons learnt from TUISR19

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Introduction

Economic growth and social development are driven by energy and water. The sustainability of both resources became a must in order to achieve development synergies to overcome the challenges of climate change and food security which are exacerbated by population growth and urbanization which create a dynamic baseline against which to address service access. Efficiency of energy and the effective deployment of renewable energy resources along with mitigation of water pollution can reduce costs of energy and water provision, increase access to services, and reduce greenhouse gas emissions and hence lessen environmental impacts on economy and public health. Therefore, TUISR19 topics have met the national needs for facing the challenges arising from resource scarcity, variability, and uncertainty driven by changes brought on by population growth, and the opportunities driven by recent technological advances and policy developments. The event addressed many issues that contribute to the implementation of strategies, and promote and disseminate knowledge about the various integrated and intelligent technologies for the safe, secure, sustainable, and affordable renewable energy and water resources. Adding to that, the most suitable and effective ways to design, finance, and build better and more sustainable resources with a common vision to identify threats, risks, and key opportunities to drive future investments in both renewable energy and water resources have been explored in the proceedings of the TUISR19 successful event. Nine topics were discussed and research results were presented in a compelling manner on novel technologies and applications of the renewable energy and water systems

covering issues of (1) technologies of renewable energy and energy storage; (2) new materials for energy applications; (3) water management and crop composition; (4) water treatment and desalination; (5) media: energy and water issues; (6) environmental hazards and therapeutic uses; (7) legal challenges and economic concepts; (8) future trends in energy, water sustainability, and climate; and (9) remote sensing techniques and GIS applications.

This special issue cannot fully reflect the diversity and creativity of the ideas and new insights that were shared at TUISR19. However, as editor of this special issue and member of the scientific committee of the event, I hope that this issue may prompt scientists from the diverse fields to participate in the upcoming conferences at Tanta University to come: the collected papers show and justify the strong position of the adopted techniques in worldwide studies to help solve problems related to the renewable energy sources and water sustainability.

Results and discussion

Renewable energy sustainability

For renewable energy productivity enhancement, several articles addressed the importance of the solar still geometry and heat transfer fluids in multi-cavity solar receivers (Duraismy Ramalingam et al. 2019), use of water film cooling and hybrid composite insulation (Balachandran et al. 2019a), use of thermally conductive nano-ferric oxide (Balachandran et al. 2019b), and the optimal sizing of hybrid solar/wind/hydro-electric pumped storage energy system based on different meta-heuristic techniques (Diab et al. 2019). The professional use of cement-coated red bricks for augmenting the production of distilled water using a traditional single slope solar still by low-cost energy storage was investigated in Kabeel et al. (2019). Three different designs of a hybrid PV/T double-pass finned plate solar air heater have been evaluated in Hegazy

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et al. (2020). Mathematical model that was experimentally validated for square pyramid solar still has been addressed in El-Sebaï and Khallaf (2020). Madhu et al. (2020) investigated the experimental enhancement of heat transfer through conventional and staggered fin solar air heater coated with CNT-black paint. For diesel engine exhaust emission control, Solomon et al. (2019) addressed the development of electrochemical cells based on the electrochemical decomposition of NO_x and oxidation of HC and CO emissions.

At varying flow rates of air and water, Duraisamy Ramalingam et al. (2019) studied the inferences on the effects of geometries and heat transfer fluids in multi-cavity solar receivers. Results revealed that receivers made up of SiC material proved superior in thermal performance to that made of aluminum and copper. The heat transfer fluids of air and water achieved the maximum energy efficiency of 21.11% and 75.81%, at flow rate of 1.35 l/min and 0.9 l/min, respectively. Balachandran et al. (2019a) addressed the productivity enhancement of PV/T-integrated single slope solar desalination still using water film cooling and hybrid composite insulation. Results clarified the increase of 35% and 21% in the amount of distilled water by using water film cooling over glass cover and HNFC insulation at 0.5-cm and 1-cm depths, yielding 2.253 and 1.420 l/m²/day, respectively, when compared with the conventional type SSSDS with polystyrene—Styrofoam (thermocool) insulation.

In order to fetch new technologies to resolve water scarcity by desalination of saline water, Balachandran et al. (2019b) investigated the efficiency of single-sloped solar still using thermally conductive nano-ferric oxide. The cumulative yield for nano absorbent layer solar still (4.39 kg/m²) proved superior to that for the micro absorbent layer solar still (3.23 kg/m²).

In order to minimize the cost of energy from the hybrid system while satisfying the operation constraints including high reliability of the hybrid power supply, small fluctuation in the energy injected to the grid, and high utilization of the photovoltaic and wind complementary properties, Diab et al. (2019) addressed the potentiality of the optimal sizing of hybrid solar/wind/hydroelectric pumped storage energy system based on different meta-heuristic techniques. Hegazy et al. (2020) studied three different designs of a hybrid PV/T double-pass finned plate solar air heater (DPFPFAH). The PV module is used to produce electricity needed to run the pump and blow the air into the solar collector. The third design of the hybrid systems where the PV module is completely separated from the solar collector has the highest overall performance. The daily thermal efficiencies of the first, second, and third designs of the hybrid systems are obtained as 53%, 27%, and 64%, respectively, at mass flow rate of 0.02 kg/s. El-Sebaï and Khallaf (2020) presented a mathematical model that was experimentally validated for square pyramid solar still where the daily productivity of the pyramid solar still

(P_d) varied from 4.22 to 4.43 kg/m² day with values of the glass cover's tilt angle of 10–60°. Values of the top losses of the still decreased from 8.8064 to 8.2304 W/m² K with increasing glass cover surface area from 0.063 to 0.125 m², which correspond to values of tilt angles of the still covers changing from 10 to 60°, respectively. Kabeel et al. (2019) addressed the professional use of cement-coated red bricks for augmenting the production of distilled water using a traditional single slope solar still by low-cost energy storage. They stated the improvement of about 34% in the temperature of water which acts as the driving force for evaporation and hence the productivity was enhanced by 45% as compared to the conventional solar still. NO_x emission has a serious effect on the environment, and it has to be controlled effectively. Madhu et al. (2020) investigated the experimental enhancement of heat transfer through conventional and staggered fin solar air heater coated with CNT-black paint. Results revealed that the effect of coating improved the plate temperature to a maximum of 102 °C while the modified solar air heater (SAH) coated with ordinary black paint and staggered fin arrangement is found as 95 °C for the flow rate of $m_f = 0.03$ kg/s.

For diesel engine exhaust emission control, Solomon et al. (2019) addressed the development of electrochemical cells based on the electrochemical decomposition of NO_x and oxidation of HC and CO emissions. The developed cells operated at low power with reduced complexity works efficiently in the oxygen-rich diesel exhaust proved high NO_x decomposition rate of 80% at the exhaust temperatures between 350 and 400 °C. The HC reduction has reached up to 65% and CO reduction has been achieved up to 45%.

Water sustainability

For addressing stresses on water resources sustainability management, water quality parameters of lake water induced by climate change (Shalaby et al. 2019), rainwater harvesting (Gado and El-Agha 2019), and drainage water salinity and quality (El-Agha et al. 2019). Gemeay et al. 2019 addressed the feasibility of removal of four commercial reactive wool dyes from industrial wastewaters, hence decreasing the potential hazardous of nanomaterial to the environment.

Shalaby et al. (2019) investigated the impacts of future climate change (CC) on water quality parameters of Lake Burullus monitored at twelve stations throughout the lagoon. The results showed that CC has the potential to radically alter the physical and chemical structure of Lake Burullus as it is expected to be warmer and more saline. The risk of oxygen depletion was firmly predictable with significant spatial differences of DO decreasing. A prolonged residence time is expected, accompanied by an increasing trend of phosphate and chlorophyll *a* and a decreasing trend of nitrate. Gado and El-Agha (2019) demonstrated that the implementation of

rainwater harvesting-RWH system has a significant impact on the regional water cycle, where the effective infiltration coefficient increased from 10% (No-RWH) to 75% (RWH) in the case study. Accordingly, the runoff coefficient decreased from 0.8 (No-RWH) to 0.15 (RWH), and the volume of runoff decreased by around 82% than that of the No-RWH condition. Thus, direct infiltration of RWH into an aquifer can play an important role in sound water management for urban environments, as this may lead to a significant reduction in risks of flooding and expenses of municipal drainage systems installation and operation. Drainage water quality variation in space and time has been addressed in El-Agha et al. (2019). Gemeay et al. 2019 addressed the feasibility of removal of four commercial reactive wool dyes from industrial wastewaters, hence decreasing the potential hazardous of nanomaterial to the environment.

Environmental health issue

In terms of the environmental health consequences impacted by natural factors such as work stresses, Hassan et al. (2020) investigated the effects from prolonged working hours, sleep deprivation, and high job demands on 278 physicians at Tanta University Hospitals between December 2016 and February 2017. Medical residents experienced moderate to high level of job stress resulted from the underpayment for the job (87.4%), serving to large number of patients (85.2%), disruption of home life due to long hours at work (83.9%), conflict of responsibilities (81.3), and complying with increasing bureaucratic procedures (78.8%) besides no available fund for research (74.8%). Abd-Elkader et al. (2020) highlighted the increasingly alarming phenomenon of tramadol abuse among the Egyptian Community. A total of 900 persons, 300 males chosen randomly from three groups; minibuses drivers, construction, and textile industries workers were cross-sectionally studied. Tramadol intake was high at 92.3% among the construction workers followed by 53.0% among the bus drivers, and lastly 25.3% among the textile workers. Friends of 45.4% and drug dealers 16.6% are the main source of tramadol. Mood improvement (54.3%), pain relief, and help to continue work (37.3%) are the main reasons of abuse.

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