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Advanced technological options for sustainable development of energy, water and environment systems upgrade towards climate neutrality

ABSTRACT

Scientific research development in energy, water and environmental systems is vital for climate change mitigation and adaptation. In this regard, the outcome of the 17th Conference on Sustainable Development of Energy, Water and Environment Systems was reviewed and presented in this editorial. Examining recent scientific developments, thirteen research articles on this special issue are related to specific topics. The topic of industrial energy reduction potentials and alternative fuels were discussed in the articles 1) Electricity demand reduction through waste heat recovery in olefins plants based on a technology-agnostic approach, 2) Integration of a rSOC-system to industrial processes, 3) Spray combustion of fast-pyrolysis bio-oils under engine-like conditions, 4) Complex aspects of climate change impacts on the cultivation of perennial energy crops in the Czech Republic, while residential and small scale applications were presented in 5) Experimental and theoretical analysis of a micro-cogenerative solar ORC-based unit equipped with a variable speed sliding rotary vane expander, 6) Exergy-Optimum coupling of radiant panels with heat pumps for minimum CO_2 emission responsibility and 7) State-of-the-art review of micro to small-scale wind energy harvesting technologies for building integration and 8) Dynamic simulation of a 4th generation district heating network with the presence of prosumers. Potentials of renewable energy increased penetration and measures and strategies for CO_2 emissions reduction presented in 9) An evaluation of the synergy between the wave and wind energy along the west Iberian nearshore, 10) Energy efficiency improvement in multi-family houses in Kosovo, 11) Natural lighting performance of vernacular architecture, case study oldtown Pasa, Ecuador, 12) Diagnosis of the building stock using Energy Performance Certificates for urban energy planning in Mediterranean compact cities. Case of study: The city of València in Spain and 13) Carbon insetting as a measure to raise supply chain energy efficiency potentials: Opportunities and challenges.

1. The 2022 SDEWES conferences special issue editorial introduction

The persistent issue of climate change confrontation is addressed as one of the major challenges of the current era. Immediate and viable actions are required, based on the distance between established technical and scientific knowledge and its feasible applications. European Green Deal, the latest EU Renewable Energy Directive, and UN Sustainable Energy Agenda are forming the pathway for the technological and policy development towards a carbon–neutral society.

A worldwide researchers' team has been formed from the Sustainable Development of Energy, Water and Environmental Systems (SDEWES) conferences contributing to scientific knowledge growth to provide solutions for climate change abatement.

The first Conference on Sustainable Development of Energy, Water and Environment Systems (SDEWES) was held in Dubrovnik in 2002. The SDEWES conference series has provided a forum for scientists and those interested in sustainability to share the art state, future directions and priorities. The 17th Conference on Sustainable Development of Energy, Water and Environment Systems (SDEWES) was held 06–10 November 2022 in Paphos, Cyprus and it has brought together 496 scientists, researchers, and experts in the field of sustainable development from 52 countries and 6 continents, out of which 349 attended onsite and 147 online. The Conference incorporated 337 oral presentations in 34 regular and 14 special sessions, four plenary lectures, and two panels given by some of the most distinguished experts in the field.

A total of 13 research articles have been published in Energy Conversion and Management-X journal [1–13]. This special issue presents the latest SDEWES community research contributions that use the energy, water and environmental systems integration to realize opportunities for a more sustainable future.

2. Power demand reduction and alternative fuels in industrial applications

Several options have been proposed for the improvement of industrial applications performance, dealing with efficiency increase and diversification of fuels and energy production schemes. The potential of industrial Waste Heat Recovery for plant-scale electricity demand reduction was investigated by Abdullah M. Maghrabi et al [1] focusing on bulk chemicals plants, represented here by olefin production facilities. The cases of direct onsite power generation; enhancement of existing power generation processes; and the reduction in power consumption by compressor efficiency improvements through waste-heat-driven cooling were simulated and investigated taking into consideration organic Rankine cycle (ORC) and absorption systems applications. The results of the conducted analysis demonstrate relatively strong relationships between simple technology-agnostic thermodynamic performance predictions and data provided by ORC and absorption chiller manufacturers. This approach eliminates the need to make detailed design decisions, such as specifying the working fluids and the

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configuration of these technologies, at this early stage of technology screening. The analysis of specific characteristics of five countries resulted in identification of the potential to reduce emissions by between 5000 tCO_2(eq.)/year and 101,500 tCO_2(eq.)/year depending on the scenario. The marginal abatement cost of the proposed solutions ranges from 1200 $/$tCO_2$(eq.) to 35 $/$tCO_2$(eq.), with a payback time between 1.5 and 8 years depending on the scenario considered. The utilization of waste heat has also been examined by Ch. Wang et al [14] focused on the application of a low-pressure economizer for waste heat recovery from the exhaust flue gas before entering a flue gas desulphurized (FGD)in a 600 MW power plant. The work deals with the simulation of the installation of a low-pressure economizer after the Electrostatic Precipitator (ESP) and before FGD recovering waste heat from uncleaned flue gas. Taking into account its proposed suitability for many types of coals and the considerations on low-temperature acid corrosion, the calculated expected benefits are the reduction of the fuel consumption by 8316 t Standard Coal Equivalent/a, of water consumption by 125160 t/a in FGD and of 15,300 t/a of CO_2 emissions. Furthermore, the potential of Waste Heat Recovery from District Heating Boiler Slag in the case of Coal-fired boilers of 45 MW thermal capacity was examined by M. Tańczuk et al [15]. According to the analysis of the utilization of high-temperature slag from grate-fired boilers could result in a range from 58.8 % to 88.0 % of energy slag potential. The work was based on the proposed modifications either by direct heat recovery in the existing slag trap or by further extending a worm conveyor tube covered by a heat exchanger coil.

Further to that promising technologies integration to industrial processes was examined and specifically the application of a reversible operated high-temperature solid oxide cell system (rSOC-System) towards its transition to renewable electricity production and electrification by David Banasiak et al [2]. The different modes considered deals with Fuel Cell operation with hydrogen as fuel (FC-H2), Fuel Cell operation with methane from a gas grid as fuel (FC-CH4) and Electrolysis Cell operation (EC), with the option of storing the hydrogen or providing hydrogen to external processes or market. Energy-intensive industries such as Cement, Glass, Lime, Refractory, Steel, Meat-processing, Brewery, and Textiles Grain mills, for typical plant sizes in Austria, were investigated for coupling with rSOC-Systems. The possible thermal coupling in both operation modes (EC and FC), results in high system efficiencies in all possible scenarios. This makes the integration of rSOC Systems to industrial sites, from a viewpoint of efficiency, much more interesting, than nodes in the energy grid, where little thermal coupling can be achieved. In addition, if there is an industry with moderate temperature (>100 ∘C) waste heat, that operates also processes with high-temperature heat demand, the rSOC-System could act as a heat pump and storage. Techno-economic assessment of reversible Solid Oxide Cell integration to renewable energy systems in civil environments such as hotels, offices and hospitals based on data recorded in one year on the island of Procida, Italy was studied by M. Lamagna et al [16]. The simulations were carried out by MATLAB model while ConfigDym built by Sylfen was used. Different conditions and scenarios were examined in the real operative settings simulation of rSOC and the results present an important decrease in emissions and an energy self-sufficiency increase of at least 29 % and 58 % respectively. The economic analysis shows a payback period currently near its lifetime, while in the future three years can be reached.

Alternative fuels and specifically biomass-derived fast-pyrolysis bio-oil (FPBO) were investigated by Yu Wang et al [3] for fueling stationary diesel engines for combined heat and power applications. The experimental investigation carried out deals with spray combustion of FPBO/ethanol blends in a constant-volume combustion research unit, where a heavy-fuel oil (HFO) injection system was adapted. Heat release analysis and high-speed imaging techniques visualizing natural luminosity of spray flames were used. Based on the results the increase of injection pressure from 300 to 900 bar improves the atomization quality, ignitability, and nozzle durability of FPBO. It was also stated that FPBO has a lower chemical reactivity while the peak heat release, in comparison with diesel, presents a lower sooting tendency. Small amounts of ethanol addition could improve fuel atomization and further lower the sooting tendency and ethanol addition has a slight influence on FPBO ignition processes, which is retarded by 10 % ethanol addition and being advanced by 30 % ethanol addition. A control-oriented dynamic model of a newly designed cogeneration plant fuelled with fast-pyrolysis bio-oil was presented by Asadzadeh, S. M. et al [17] including a modified diesel engine operating on FPBO, a newly designed flue gas burner that oxidises FPBO only with the oxygen content of engine flue gas, and a dedicated flue gas treatment system to remove CO, HC, and NOx. The system is a hybrid diesel generator/flue gas boiler plant for electricity generation and water/space heating. The model is parameterised and partially validated using measurements from a turbocharged four-cylinder diesel engine and a swirl burner, both running on fast-pyrolysis bio-oil. Results show that the feasible operation region area of the hybrid engine/boiler system is 100 % larger than that of the CHP engine. The hybrid plant can achieve energy efficiencies above 85 % in response to the fluctuating load demand of a hospital. The work of Fábio Codignole Luz et al [18] is focused on the numerical modeling of a shaftless screw fast pyrolyzer with special attention on the residence time distribution and the definition of the kinetic framework, as well as the heat and mass transfer phenomena representation and its comparison with experimental results from fast pyrolysis of spent coffee grounds in a lab-scale screw reactor. Results show that temperature profiles for both the gas and solid phase are in good agreement with experimental data and that peak bio-oil production has been observed in the range of 500 °C. The results also show a strong dependence of results on wall temperature and gas–solid heating rate.

The utilization of Perennial energy crops, called also second-generation energy crops, as a significant renewable energy source for Central Europe was examined by Kamila Vávrová et al [4] The methodological approach used involves analysis of primary data on the change in the parameters defining the climate region, use of GIS database for both conventional and energy crops and modelling of the biomass potential for the changed climate conditions. According to the results based on various modelled scenarios, biomass yields could increase and energy crops with their proper allocation. Also, results based on long-term field experiments of second-generation crops many of the varieties used in practice will be capable of adapting to the current effects of climate change over the next two decades, while new varieties can achieve the same or even slightly higher yields. The biomass potential changes depend on the regional conditions and should be examined before expected climate changes. The case of the operation of biogas plants in advanced energy markets formed by limited energy crop availability and absence of subsidy was investigated by Robert Bedoić et al [19]. Based on the finding of not profitable participation in the day-ahead electricity market of a 100 €/MWh el selling price, it is calculated that a more profitable operation strategy involves coupling biogas power plant operation on the electricity balancing market with bio-methane production or combining a small-scale sugar beet processing facility with a biogas upgrading plant to cover heat demand for sugar beet processing. The model developed aims to investigate options in a significantly changed market of both biogas production and biogas utilization.

3. Technological solutions for residential and small-scale applications

A promising solution of a Combined Heat and Power (CHP) micro production below 1 kWelectric involving a Solar based Organic Rankine Cycle (ORC)-based power units was investigated by Fabio Fatigati et al [5] focusing on the impact of the expander revolution speed variation on a solar micro-cogenerative ORC unit. The unit was experimentally and theoretically characterized. A fully instrumented ORC-based power unit was developed and a Sliding Rotary Vane Expander was tested in steadystate conditions over a wide operating range characterized, as well as it was theoretically modelled. Through the experimental work, it was concluded that an optimized speed profile allows for to maximize the expander power; to optimize the expander efficiency and the ORC plant power and efficiency. It is also important that the expander revolution speed variation allows avoiding the ORC plant over designing. Maria Alessandra Ancona et al [20] estimated the electricity production obtainable by coupling an existing recuperated Organic Rankine Cycle (ORC) prototype of maximum capacity 1800 W developed in the micro-generation laboratory of the University of Bologna (UNIBO-ORC test bench) with a commercial solar thermal collector considering the reduction of single-family user yearly electricity purchase. In the case of operation of an integrated system with the use of HFC-134a, the reference fluid for low-temperature ORC, 39 % of the yearly electricity demand, or more than 1150 kWh can be covered by the system. Different low global warming potential fluids and blends were also examined resulting in lower net power output production and covering barely 16 % with R1234yf and 17.5 % by R513A blend. Three variants of CHP plants fuelled by sawmill biomass with the use of ORC for electricity production were examined by A Borsukiewicz-Gozdur et al [21]. The system efficiency was calculated based on four different working fluids namely octamethyltrisiloxane, methylcyclohexane, methanol and water. The analysis resulted in the use of water or methanol are proposed for the wood processing plants, the use of dry organic fluids (Methylcyclohexane, MDM) with internal regeneration achieves higher electric power values, while the absence of internal regeneration achieves higher temperature of drying air. As concluded, according to the desirable operating parameters of the biomass ORC power plant, the proper working fluid can be selected.

This minimization of carbon dioxide emissions in the case of radiant heating or cooling panels coupled with heat pumps was investigated by Birol Kılkış [6], using an exergy-based optimization model. Discussing the gap of optimum tube spacing in radiant panels for minimum carbon dioxide emission according to the second law with or without using heat pumps or boilers for temperature peaking or chillers for cooling, an Exergy-Based model was developed and used. The best approaches to the minimum or nearly zero CO_2 emissions were investigated taking into account the embodied CO_2 emissions of the hydronic tubing material, the laymen ship, the ancillary material of radiant panels, and their operating emissions. Nearly avoidable (ΔCO_2) and direct emission (CO_2) modes and mitigation potential by replacing fossil-fueled systems, were analyzed in three categories namely 1- Radiant panels with hydronic tubing, 2- Electrically-operated heat pumps, 3.a- Fossil fuel replacement with renewables (including heat pumps if COPHP exceeds eight in heating), and 3. b- Radiant Ceiling Panel with heat pipes and solar energy for indoor cooling. Results show that negative-carbon solar heating with radiant panels may be achieved with real roots available for optimum tube spacing. Optimal tube spacings for ceiling cooling panels also exist. The development of photovoltaic systems in Poland was studied by M. Dzikuć et al [22]. Due to state support, photovoltaic micro-installations have been developed in recent years. The current discounts in the settlements system for photovoltaic installations will be not available for new market entrances after April 1, 2022, subject to the risk of slower growth. New technical possibilities and economic conditions of energy storage in households are elements for new system developments. This work of Giovanni Barone et al [23] deals with the design of an innovative low-cost air-based photovoltaic/thermal collector prototype, implemented to reduce the photovoltaic cells temperature and to recover thermal energy. A prototype was experimentally tested, while a simulation model implemented in MatLab was used for its validation in different operating conditions. The novel system was coupled to an air-to-air heat pump for building space heating and assessed for 8 different European weather zones. Simulation results show an estimation of primary energy savings (11.0–19.7 MWh/year corresponding to 52–80 %), avoidance of carbon dioxide emissions (4.64–10.4 t CO2 /year), and simple pay-back periods (3.2–4.8 years).

The utilization of wind power in buildings using micro to small wind turbines was thoroughly investigated by Katrina Calautit et al [7]. The work deals with the identification of the technological state of the art the complex operation conditions as well as wind harvesting and power production. Different types of horizontal and vertical axis wind turbines as well as various configurations were discussed and modeled using computational fluid dynamics and blade element momentum methods. Based on the reviewed studies, various designs and mechanisms for wind energy harvesting systems were presented and investigated as well as wind-induced vibration technologies, modelling and results of modern configurations and their technical and power characteristics. It was concluded that the installation of wind energy harvesting systems on roof building structures provides the advantages of local production, improves energy efficiency and reduces carbon footprint. The experimental measurements of the performance of a micro-wind turbine located in an urban area have been investigated by Marco Pellegrini et al [24]. It is recognized that micro-wind turbines contributing to decentralized energy generation of energy, reduction of greenhouse gas emissions and supporting the transition to transport system electrification, present barriers including highly site-specific characteristics and less predictable performance estimation than other renewable sources in an urban framework. The work carried out deals with more than 12 months of outdoor extensive monitoring activities carried out on a commercial micro-wind turbine at the HEnergia centre in Forlì (Italy) and the technical and economic performances assessment. The results show that installations in very low annual average wind speed sites, such as the one in Forlì, Italy, are not favourable for this technology and further improvements could be taken into account for its applicability improvement. The evolution of District Heating Network and its transition from centralized production to the 4th generation concept of lower operation temperatures and renewable energy sources integration promotes systems decarbonisation and the "prosumer" schemes was examined. The increasing presence of prosumers requires accurate dynamic modelling of the thermohydraulic parameters of the network, the subject of the work of T. Testasecca et al [8], carried out under the TRNSYS environment. The case of 10 residential users was examined located in Palermo (Italy), taking into account network support by solar collectors and cooling by absorption chiller. The Base Case refers to a classic 3rd generation DHN without prosumers. Combining evacuated tube solar collectors and lowering supply temperature from 100 ∘C to 80 ∘C and then to 60 ∘C led to 26.4 % and 52.8 % reduction in thermal losses, while the inclusion of solar collectors led to heating energy savings above 25 % during the heating period. The additional introduction of two prosumers led to energy savings of 27 % for pumping and a 31.3 % reduction of the thermal energy requested by CHP during the heating period. Modelling a fifth-generation bidirectional low-temperature district heating and cooling (5GDHC) network for nearly Zero Energy District (nZED) was conducted by Matteo Bilardo et al [25] based on an hourly dynamic energy balance network simulation combining MATLAB and Simulink development platforms. The potential of these networks using lower working temperatures close to the ground temperature, usually between 10 and 25 ∘C was examined, coupling several users within a bidirectional fifth-generation network based on the integration of reversible heat pumps with on-site production by renewable sources and waste energy recovery. The results obtained show that the thermal efficiency of the network, assessed utilizing a specifically defined index, is equal to 1.69, while the percentage weight of the electric need and thermal integration are 19 % and 41 % respectively.

4. Renewable energy penetration and energy management prospects

The work of Liliana Rusu [9] was dedicated to the examination of wave and wind power along the west Iberian coastal environment and its potential contribution to the green production economy. Both energy sources were evaluated for two 20-year periods namely 2001–2020 and 2026–2045. Data from ERA5 wind data used for the first period and RCA4 (Rossby Centre regional atmospheric model, version 4) were processed for the second while spectral phase averaged model SWAN (Simulating WAves Nearshore) have been performed for wave power. Climate scenario RCP4.5. (Representative Concentration Pathway) was taken into consideration. Based on the work carried out, the development of joint wind–wave projects is a viable near-future solution in the case of the west Iberian coastal environment and especially the Northwestern part of the Iberian nearshore. The western part of the Black Sea has been also evaluated by PLiliana Rusu [26] paying special attention to the Romanian nearshore. Based on the US National Centres for Environmental Prediction for wind potential and using a wave modelling system, using a time window of 1987 – 2016, general patterns of wind and wave energy were established. The evaluation resulted that along the Romanian coast and continuing to the north close to the coastal area of Ukraine (up to Odessa), there are suitable areas for combined wind-wave exploitation. Even though no significant trends were found as regards the wind and wave power, both resources have a strong peak in the winter, matching the increased regional energy demand. A review of the Environmental Impact of Solar and Wind energy was carried out by Tareq Abu Hamed et al [27]. Taking into account the fast growth of solar and wind energy, contributing to the reduction of greenhouse gas emissions as targeted by many countries, a deep and wide investigation of their environmental impact before their construction was made dealing with land use, water consumption, impact on biodiversity, visual and noise effects, health issues and impact on microclimate. Proper planning and attention could result in lowering their impact which can occur in some regions and comprehensive environmental assessment should be made.

An Energy efficiency analysis for space heating for multi-family houses in Kosovo was conducted by Bukurije Hoxha et al [10]. Based on MESP Regulation no. 04/18 for buildings built from 1960 to 2017. Heat transfer coefficients for the envelope surface were examined were analysis of energy savings for heating was taken into account considering only the heat losses in the building envelope (transmission losses). According to the results analysis, poor energy performance was observed in the areas of walls, doors and windows, floors and roofs. Savings can be achieved by implementing MESP Regulation no. 04/18 for Minimum Requirements for Energy Performance of Buildings under law 05/L-101 on Energy Performance in Buildings of the Republic of Kosovo. The assessment of the annual CO_2 emissions directly related to campsite management and the consequent environmental impact in campsite clusters in Tuscany was examined by Deny Del Moretto et al [28]. The software i-Tree Canopy was exploited, while energy and water consumptions from 2012 to 2015 were assessed for each campsite, while distribution of sequestered CO_2, campsites was ranked according to their size. According to the indicator "T-Tree" or canopy cover, a larger area of the canopy cover allows the use of fewer outdoor areas covered by trees for the sequestration of the remaining amount of pollutants. The analysis shows significant positive aspects concerning energy efficiency and CO2 emission reduction in campsites located in highly naturalistic Parks. Significant margins of possible improvement have been also discussed in the study. The Brazilian Institute of Higher Education was studied by Serra, E. G. et al [29] concerning compliance with the federal public buildings normative instruction for energy efficiency. A selected case study of one of the Institute buildings was used in which a Building Information Modeling to optimize the execution of reference instructions was applied for both the conventional method and the new method. It resulted that the new method showed classification time was reduced by approximately 85 % reduction due to its better performance in obtaining architectural design information and further potential in case of its incorporation into the project routine.

A study based on natural lighting in vernacular architecture focusing on traditional buildings in the parish of Pasa, Ambato, Ecuador, was carried out by Darío Bustán-Gaona [11]. The work was based on a multidisciplinary approach that combines on-site measurements and simulations in selected 19 case studies. Data and information were collected for each selected case study, focusing on aspects of natural lighting such as orientation, size, and location of windows, as well as shading devices and material selection. The analysis, resulted in possible interventions to improve design principles and increase natural light, from 30 to 100 lx. The work carried out by M. Beccali et al [30] targeted the use of local materials and traditional techniques as the responsible approach to building environment development. The work deals with the review of thermohygrometric comfort in natural ventilated buildings models evaluation and hot-humid climates focusing on the Mozambican building traditions. A test case of a new healthcare facility designed to be energy-autonomous with large use of natural ventilation is proposed.

The work aims to diagnose the energy performance of buildings and identify areas where energy efficiency can be improved based on the case of Valencia carried out by Á. Manso-Burgos et al [12]. Information on energy performance of the building, determined by the Spanish Government (EPCs) was used related to the annual energy demand of the building under normal operating and occupancy conditions involving heating, cooling, ventilation, domestic hot water production and, where appropriate, lighting and the deriving annual emission of CO_2 per usable floor area. Based on statistical analysis and mapping it was resulted that the building stock developed under no building standards in the 1960s and 1970s presents a poor energy performance. The worst energy performances are in peripheral districts, especially in the city's northern half and this poor performance presents a sensible correlation with low-income and low-renting rates districts. This work has shown the relevance of EPCs as an objective tool to diagnose the energy efficiency of a city's building stock.

Opportunities and challenges related to Carbon insetting as a measure to raise supply chain energy efficiency potentials in the industry were investigated by Felix Ebersold [13]. Based on literature comparison of carbon insetting and focusing on the automotive industry, the cases of GHGE reductions outside the scope of the reporting company and the atmosphere Greenhouse gases removal options were discussed in addition to the carbon footprint approach. The work shows an approach to establishing a carbon accounting for a static supply chain and how companies could use insetting as one option to account for the implementation of energy efficiency measures along the supply chain. A novel two-stage optimisation model for the efficient resources management and reduction of the carbon footprint of a waste-to-energy supply chain including optimisation and allocation of waste (Micro-stage.) and design of an integrated processing hub (macro-stage) was developed by Hon Loong Lam et al [31]. Having as a test case for application the west coast of Peninsular Malaysia. Operation and logistics management were examined and optimum scenarios were determined as well as optimum technologies.

5. Conclusions

The SDEWES research scientific contributions community addresses several important fields of technological and management improvement towards the accomplishment of climate neutrality goals, as summarized in this editorial. The thirteen articles in this special section that form the basis for this editorial, contribute to the further development of solutions for the sustainable development of energy, water and environmental systems that the SDEWES research community has consistently supported over the years.

In the first paper, the potentials of industrial Waste Heat Recovery for plant-scale electricity demand reduction was investigated taking into consideration organic Rankine cycle (ORC) and absorption systems applications [1] focusing on bulk chemicals plants, represented here by olefin production facilities. The results of the conducted analysis demonstrate relatively strong relationships between simple technology-agnostic thermodynamic performance predictions and data provided by ORC and absorption chiller manufacturers. The second paper deals with the examination of the application of a reversible operated high-temperature solid oxide cell system (rSOC-System) towards its transition to renewable electricity production and electrification [2]. The possible thermal coupling in both operation modes (EC and FC), results in the integration of rSOC Systems to industrial sites becomes more interesting than nodes in the energy grid. In the third article, alternative fuels and specifically biomass-derived fast-pyrolysis bio-oil (FPBO) were investigated [3] for fueling stationary diesel engines for combined heat and power applications. Based on the results the increase of injection pressure from 300 to 900 bar improves the atomization quality, ignitability, and nozzle durability of FPBO. Small amounts of ethanol addition could improve fuel atomization and further lower the sooting tendency and ethanol addition has a slight influence on FPBO ignition processes, which is retarded by 10 % ethanol addition and being advanced by 30 % ethanol addition. Also in the fourth paper, the utilization of Perennial energy crops, called second-generation energy crops, as a significant renewable energy source for Central Europe was examined [4]. It was resulted that under various scenarios biomass yields could increase and energy crops with their proper allocation and that based on long-term field experiments of second-generation crops many of the varieties used in practice will be capable of adapting to the current effects of climate change over the next two decades, while new varieties can achieve the same, or even slightly higher yields. In the fifth article, a promising solution of a Combined Heat and Power (CHP) micro production below 1 kWelectric involving a Solar based Organic Rankine Cycle (ORC)-based power units was investigated [5] focusing on the impact of the expander revolution speed variation on a solar micro-cogenerative ORC unit. It has resulted that an optimized speed profile is allowing to maximisation the expander power; to optimize the expander efficiency and the ORC plant power and efficiency. It is also important that the expander revolution speed variation allows avoiding the ORC plant over designing. In the sixth study, the minimization of carbon dioxide emissions in the case of radiant heating or cooling panels coupled with heat pumps was investigated [6], using an exergy-based optimization model. Results show that negative-carbon solar heating with radiant panels may be achieved with real roots available for optimum tube spacing. Optimal tube spacings for ceiling cooling panels also exist. In the seventh article, the utilization of wind power in buildings using micro to small wind turbines was investigated [7]. It was concluded that the installation of wind energy harvesting systems on roof building structures provides the advantages of local production, improves energy efficiency and reduces carbon footprint. In the eighth article, the evolution of District Heating Network and its transition from centralized production to 4th generation concept of lower operation temperatures and Renewables energy sources integration promotes systems decarbonisation and the "prosumer" schemes were examined [8] taking into account network support by solar collectors and cooling by absorption chiller, resulting in energy savings and reduction in thermal demand. The ninth study [9] was dedicated to the examination of wave and wind power along the west Iberian coastal environment and its potential contribution to the green production economy. Based on the work carried out, the development of joint wind–wave projects is a viable near-future solution in the case of the west Iberian coastal environment and especially the Northwestern part of the Iberian nearshore. In the tenth paper, an Energy efficiency analysis for space heating for multi-family houses in Kosovo was conducted [10]. According to the results analysis, poor energy performance was observed in the areas of walls, doors and windows, floors and roofs while savings can be achieved. In the eleventh article, a study based on natural lighting in vernacular architecture focusing on traditional buildings in the parish of Pasa, Ambato, Ecuador, was carried out [11]. The analysis, resulted in possible interventions to improve design principles and increase natural light. The work described in the twelfth article aims to diagnose the energy performance of buildings and identify areas where energy efficiency can be improved based on the case of Valencia [12]. It was resulted that the building stock developed under no building standards in the 1960s and 1970s presents a poor energy performance and that there is a relevance of energy performance of building, determined by Spanish Government EPCs as an objective tool to diagnose the energy efficiency of an city's building stock. Finally, in article number thirteen [13] the opportunities and challenges related to Carbon insetting as a measure to raise supply chain energy efficiency potentials in the industry were investigated. The work shows an approach to establishing a carbon accounting for a static supply chain and how companies could use insetting as one option to account for the implementation of energy efficiency measures along the supply chain.

The guest editors see considerable potential in the research articles included in this special issue. Guest editors believe these contributions will greatly interest Energy Conversion and Management readers. The highly demanding development of processes and management schemes towards the formation of viable solutions confronting climate change requires significant and consistent scientific effort and technological enhancement.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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