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Founding Chair: Prof. Dr. Ibrahim Dincer
Conference Chair: Prof. Dr. Zafer Utlu

11th GLOBAL CONFERENCE on GLOBAL WARMING

14 - 16.06.2023

HALİÇ UNIVERSITY
İSTANBUL / TÜRKİYE

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PROCEEDINGS

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11th Global Conference on

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Istanbul, Turkey

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FOREWORDS

MESSAGE FROM THE CHAIRMAN

Global Conference on Global Warming (GCGW) is a multi–disciplinary international conference on all aspects of global warming including its evidence, causes, impacts and potential solutions. This conference aims to provide a forum for the exchange of technical information, dissemination of high-quality research results, presentation of new policy and scientific developments and promoting future priorities for a more sustainable development and energy security. It covers a broad range of topics on atmospheric changes, climate change impacts, climate change modeling and simulations, energy and environment policies, energy resources and conversion technologies, renewables, emission reduction and abatement, waste management, ecosystem and biodiversity, sustainable development, etc.

GCGW has been organized successfully as a leading congress in the area since 2008, and GCGW-2023 is the 11th one of this conference series. The previous conferences were held in various parts of the world, namely four times in Istanbul, one time in Lisbon, Beijing, Athens, Doha, Zagreb, and Sharjah successfully. The scientific part of the GCGW-2023 includes plenary sessions in which keynote speakers present as well as parallel sessions in which invited papers and general papers are presented in oral form. There are also poster presentation sessions. During the conference, awards best paper and best poster awards will be given to acknowledge the high quality of work of the participants. The social part of the GCGW-2023 includes a welcoming reception and a gala dinner.

All the papers submitted to the conference have gone through a quick review process to increase the quality of these papers. Accepted papers have been published in the GCGW-2023 proceedings. After the conference ends, high-quality papers will be considered, in extended form, for publication in the special issues of the specific reputable international journals. The roadmap for World's global warming strategies was discussed with nine distinguished panellists and the moderator. 132 attendees have attended this event from 15 different countries. The GCGW-2023 has been a successful conference, and the output of this conference will definitely be another milestone in World's global warming activities.

Prof. Dr. Ibrahim DINCER
GCGW 2023 Founding Chair

FOREWORDS

MESSAGE FROM THE PRESIDENT

Global warming refers to the long-term increase in Earth's average surface temperature due to human activities, primarily the emission of greenhouse gases into the atmosphere. The most significant greenhouse gas is carbon dioxide (CO2), which is released through the burning of fossil fuels such as coal, oil, and natural gas. Other greenhouse gases include methane, nitrous oxide, and certain industrial chemicals. The effects of global warming are wide-ranging and pose significant challenges to the environment, human societies, and ecosystems.

The 11th Global Conference on Global Warming (GCGW-2023) was held successfully in İstanbul, the cultural capital of Turkey from 14th to 16th June 2023, hosted by OntarioTech University, and Haliç University in collaboration with the World Society of Sustainable Energy Technologies.

The 11th Global Conference on Global Warming (GCGW-2023) is a multi–disciplinary international conference on all aspects of global warming including its causes, impacts and potential solutions. The conference aimed to provide a forum for exchanging technical information, disseminating high-quality research results, presenting new policy and scientific developments, and promoting future priorities for more sustainable development and energy security. Participants from all disciplines related to global warming (e.g. ecology, education, engineering, natural sciences, social sciences, economics, management, physical sciences, information technology, etc) are welcome to contribute to this unique event which is held at the Haliç University this year.

GCGW-2023 had featured 8 keynote speakers, 5 invited speakers, 32 parallel sessions and 2 poster sessions. The 'Workshop for Partnership and Networking on Global Warming Technologies' was also organized within GCGW-2023 to bring the leading academicians, researchers, scientists, and students together to lead a new effective network and collaboration between the universities, industrial partners, and government. In this workshop, speakers from research groups working on global warming and sustainable energy technologies introduced their group, and presented their past and current research projects, collaborations, infrastructures, and future research strategies. A panel discussion session was also organized online on the last day of the conference. The roadmap for Turkey's global warming strategies was discussed with eight distinguished panelists and the moderator. 152 attendees have attended this event from 28 different countries. The GCGW-2023 has been a successful conference, and the output of this conference will definitely be another milestone in global warming activities.

As the Association President, I would like to register my sincere appreciation to the Organizing Committee Members, Executive Organizing Committee Members, and the Honorary Chair Prof. İbrahim Dincer. In addition, I would like to acknowledge the assistance, support and coordination of our sponsors. Last but not least, I warmly thank the congress keynote speakers, authors, session chairs, and all attendees, whose contributions and efforts made this conference a great success.

Prof. Dr. Zafer UTLU
GCGW 2023 President

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SCIENTIFIC PROGRAM

Time	Day 1 - Wednesday 14th June 2023			
08:00-10:00	**Registeration** Main Conference Hall (registeration will be open from 9:00 -18:00 wednesday 14th June)			
10:00-10:10	Opening Remarks : Professor Zafer Utlu			
10:10-10:25	Short Remarks : Professor Ibrahim Dincer			
10:25-10:40	**Music Recital** Main Conference Hall			
10:40-10:45	**Group Photo** Main Conference Hall			
10:45	**Tea Break** Main Conference Hall			
11:00-11:40	Keynote Speaker: Prof. Dr. Seeram Ramakrishna Title: **Role of Circular Economy in Net Zero Transition**			
11:40-12:20	Keynote Speaker: Prof. Dr. Mihri Ozkan Title: **Carbon capture and emission reduction via electric vehicles help to tackle climate change**			
12:20-12:35	Sponsors' speeches - RePG Energy			
12:35	Buffet Lunch			
13:30-14:10	Keynote Speaker: Prof Dr. Cengiz S. Özkan Title: **Role of Energy Storage in Electrification of Economy and Sustainability**			
14:30	**Session 1** Renewable Energies and Sustainable Chair: Nader JAVANI	**Session 2** Global Warming and Environment Chair: Moslem Sharifishourabi	**Session 3** Digitalization/Policies, Management and Economics Chair: Hafiz Muhammad Rizwan	**Session 4** Analysis Chair: Aliaksandr Pauliuchenka
	#7 "A comprehensive review of the impact of feedstock chosen in the pyrolisis precess on the emmissions of gas turbine engines" #11 "Wind and solar-based energy system with hydrogen and battery storages and heat pump for sustainable communities" #27 "Feasability and comparison of using an integrated solar-base system for a sample residental building in different cities of Russia" #36 "Technical assessment of chp system integrated with carbon capture and utilization technology" #58 "Experimental investigations to reduce CO2 emission in a single cylinder CI engine using waste plastic oil blend combined with lemon peel oil" *Topkapı*	#6 "Temperature change of a vehicle battery uring the driving cycle" #33 "Environmental Impact Assessment of a New Multigenerational System" #59 "Green future transport" #63 "Energy efficiency evaluation and forecasting of the sussex ports to adress climate change concerns: a data-driven decision model " #93 "Assessing the impact of climate change on soil moisture and *Boğaziçi*	#14 "Secapsoft software for decision making based on data analytics and carbon reduction" #26 "Confidence-Base Regression with Energy Based Models in Deep Learning" #110 "The effect of generative AI on the digitization of yhe energy sector" #45 "Economic growth and sustainability: debating the pros and cons of degrowth and green growth" #89 "Using artificial intelligence algorithms for solar energy prediction" *Taksim*	#10 "Gravitional Water Vortex Heat Exchanger as a Waste " heat recovery Unit" #17 "Dynamic thermal moeling of a greenhouse" #22 "Controller design that provides lighting automation for energy efficiency in buildings" #44 "Exergy analysis of different fuel blends powere compression ignition engine- a review" #118 "Hydrogen production from geothermal energy" *Haliç*
15:45	**Tea Break** *Venue*			
16:00-17:30	**Session 5** Renewable Energies and Sustainable Chair: Nurdan Yildirim	**Session 6** Global Warming and Environment Chair: Ebru Hancioglu	**Session 7** Digitalization/Policies, Management and Economics Chair: Nilsen Sunter Eroglu	**Session 8** Analysis Chair: Mehmet Ziya Söğüt
	#29 "Optimization and development of a water- energy-carbon nexus model: a techno-economic analysis" #55 "Techno-economic and environmental analysis of the integration of solar tracked or fixed-tilt photovoltaic power plants to open coal" #46 "Plastic recycling in a R&D office: recycling of plastic waste as granules and fibre" *Topkapı*	#112 "A study on global warming effect of Gas Turbine Power Generation Process" #43 "Assessment of environmental protection costs within the framework of global warming" #40 "Ecospace program as the transition of civilization to the natural path of technocratic development" #23 "Ust biosphere technologies for solving global environmental problems" *Boğaziçi*	#92 Optimization of carbon trading and renewable energy management by using blockchain technology and artificial intelligence" # 98 "Confidence-Based Regression with Energy- Based Models in Deep Learning" # 104 "The geostrategic and economic impact of Türkiye's hydrogen energy vision on Europe" #129 "Holistic chain management of environment, matter, energy and processes with artificial intelligence for sustainable tourism industry" *Taksim*	#48 "Transformation of a touristic facility to cogeneration system and thermoeconomic analysis" #64 "Energy, Exergy and Emission Performance Prediction of the Hydrogen-Fueled Scimitar Engine with Machine Learning Methods" #67 "Machine learning methods for the prediction of CO2 emissions in spark-ignition engines" #68 "Sustainability: technological development, growth and environmental pollution" *Haliç*
17:30	**Close**			

10.40	Venue: Small Conference Hall			
10.40	COMFORT BREAK			
10.45-12.30	**Session 9** **Renewable Energies and Sustainable** Chair: Sahver Omeraki Cekirdekci #60 "Effects of green finance on renewable energy generation in Turkey" #66 "Reduction of CO2 emissions and combustion stability in lean limits by optimizing the engine spark timing for hydrogen induction in gasoline" #75 "Sustainable formic acid production from CO2: a life cycle assessment analysis" #71 "Investigation of hydrogen production potential based on an ocean thermal energy conversion plant; thermodynamic performance" *Topkapı*	**Session 10** **Global Warming and Environment** Chair: Ali Ayati #108 "Mof-doped mxene for CO2 adsorption" #39 "An environmental impact comparison of thermochemical cycles and steam methane reforming for hydrogen production processes " #123 "Investigating the impact of green certificate campus. implementation on greenmetric in university campuses" #56 "The use of enhanced carbon nanotubes (CNT AND CNT/PVA) obtained from composite packaging wastes as carbon dioxide adsorbent" #74 "Investigation of Life Cycle Assessment for Rural Wastewater Treatment Plants" *Boğaziçi*	**Session 11** **Renewable Energies and Sustainable** Chair: Nurdan Yildirim #50 "Characterization of carbon nanotube enhanced composite phase change material derived from waste Idpe" #115 "System design for green power generation with piezoelectric materials" #97 "Surface plasmon resonance-mediated optical tunability and photocatalytic activity in Ag- DECORATED Cd0.5Zn0.5S Photocatalysts #101 "Performance evaluation of geothermal assisted VAC system with LiBr-H2O for residential cooling" #105 "Thermal storage units as a peak shaving product for energy and building sector integration" *Taksim*	**Session 12** **Analysis** Chair: Mahdi Deymi-Dashtebayaz #85 "Determination of electricity, heating-cooling and hydrogen production performance by using externally fired gas turbine flue gas in turbine- bleeding regeneration SRC, ORC, Li-Br/H20 absorption chiller and electrolysis unit" #86 "Thermo-economic analysis of green hydrogen production using diesel engine at different loads of exhaust waste heat in SRC and ORC-IHE with zeotropic and low GWP fluids integrated with thermoelectric generators" #87"Investigation of exergetic and environmental performance of freezing food considering cryogenic cooling" #52 "Net zero energy building in the United Arab Emirates: Life cycle assessment of global warming potential" *Haliç*
12.30-13.30	**Buffet Lunch**			
13.30	**Session 13** **Renewable Energies and Sustainable** Chair: B. Koray Tuncalp #77 "Remote sensing technologies for renewable energy management" #79 "Butyrate generation during the fermentation of bio-hydrogen as a green chemical" #82 "Development of phase change material microcapsules and composites using a green method" #57 "A lesson proposal for using the circular economy in design education" *Topkapı*	**Session 14** **Global Warming and Environment** Chair: Meltem Vatan # 25 "The effect of the construction industry on global warming and solution suggestions" #34 "Minimization of greenhouse gas emissions from groundwater treatment using biochar derived by solar pyrolysis in compliance with EU green deal" #53 "Environmental comparison of different coal-fired technologies used by thermal power plants via life cycle assessment" #102 "Environmental impact investigation of using hydrogen sulfide and waste-based hydrogen in blending with black sea natural gas" *Boğaziçi*	**Session 15** **Renewable Energies and Sustainable** Chair: Neslihan Colak Gunes #72 "Performance analysis of a biomass-based Brayton and supercritical- CO2 integrated power plant" #70 "Environmental Effects of Pretreatment Processes Applied to Cotton Fabrics" #119 "Evaluating the impact of solar energy systems on exergy efficiency and carbon footprint in extra virgin organic olive oil production" #18 "A life cycle assessment study for sustainable denim fabric production" *Taksim*	**Session 16** **Analysis** Chair: Ozum Calli #94 "Determinants of the countries' performances regarding climate change" #96 "Assessment of environmental impact of irreversibility in a cooling section of dry-type cement production plant" #69 "Retrofit scenarios for overheating problem of a studio-type housing in the mediterranean climate" #114 "A Comparative Study for Electrical Energy Forecasting Using Random Forest and Decision Tree Methods" *Haliç*
	Poster session: #4 "Numerical investigation of hybrid thermal photovoltaic system performance for ship propulsion in Arabian Gulf" #28 "Navigating toward sustainability: impact of using marine pilots in ports sustainability" #31 "Energy efficiency and solar energy impelimantation opportunities for dairy farms #78 "Comparison of traditional and innovative thermal insulation materials in terms of energy efficiency" #84 "Preparation of microcapsules containing phase change materials for passive cooling in computers #109 "Simulation-based study of natural gas to hydrocarbon liquids (gti) process using fischer-tropsch synthesis: a case study of neem field in western Sudan" #111 "Photocatalytic reduction of carbon dioxide into methanol over copper based metal organic framework" #116 "Solar radiation and energy efficiency: analyzing the impact on cooling and heating in different climatic regions" # 127 "The effects of global warming and climate change on human health"			
14.45	*Tea Break*			
15.00	**Session 17** **Renewable Energies and Sustainable** Chair: Ahmet Durmayaz #24 "Recycling perovskite materials for sustainable solar technologies: Recovery of high cost fto substrates" #88 "Investigation of O2 ratios on structural and optical properties of ito films for high-efficiency silicon heterojunction solar cells" # 100 "A study on green hydrogen production potential in Canada" *Topkapı*	**Session 18** **Global Warming and Environment** Chair: Eralp ÖZİL Paris Agreement, COP 27, IPCC Synthesis Report, UN 2030 sustainability platform, and local governments in Turkey #124 "A case study of carbon footprint measurement in university campus" #61 "Calculation of the footprint of a local government in Turkey: The case of Seydikemer district" #62 "Estimation of the cost of converting all road transportation vehicles in Turkey to net zero emitting electrical vehicles by 2035 #65 "Eco friendly production options in sanitary ware industry: Carbon footprint and sustainability approach" *Boğaziçi*	**Session 19** **Renewable Energies and Sustainable** Chair: Yeliz Konuklu # 83 "Humic acid based phase change material microcapsules for thermal energy storage" #54 "A Study of Hydrogen Production Potential via Iron-Chlorine (Fe-Cl) and Magnesium Chloride (Mg- Cl) of the A Fusion Reactor " # 18 "Life cycle assessment of different energy sources for municipal gasification system" #51 "Graphene nanosheet synthesis from waste plastics via pyrolysis" *Taksim*	**Session 20** **Renewable Energies and Sustainable** Chair: Melik Ziya Yakut #120 "Enhanced exergetic performance of a geothermal-based organic rankine cycle through employing partially evaporated working fluid" #121 "Evaluation of inverter types used in solar energy systems with multi-criteria decision making (MCDM) #122 "Evaluation of solar based green hydrogen production technologies with multi-criteria decision making (MCDM)" #38 "Reduction of energy costs from groundwater treatment using biochar application in terms of water-energy nexus: Development of energy cost indicator" *Haliç*
16.45	*Tea Break*			
17.00-17.30	Keynote Speaker: Prof. Dr. Birol Kilkis Title: Micro Fuel Cells for Combined Heat and Power in the Quest of Decarbonization versus Complete Electrification in EU Countries Venue: Small Conference Hall			
	Leaving by buses for the gala dinner			
18.30	Gala Dinner & Awards Ceremony			
22.00	Close			

Time	Day 3- Friday 16th June 2023			
09:30	Keynote Speaker: Prof. Dr. Sandro NIZETIC Title: The role of Photovoltaic Technologies in Energy Transition			
10.10	Keynote Speaker: Prof. Dr. Abdul-Ghani OLABI Title: Digital Twin & Artificial Intelligent for Renewable Energy & Energy Storage Systems Venue: Small Conference Hall			
10.40	COMFORT BREAK			
	Session 21	Session 22	Session 23	Session 24
10.50	**Renewable Energies and Sustainable** Chair: Salahaddin Bendak #21 "Sustainability relevance in micro-volume housing" #73 "Water footprints in denim production" #32 "Performance of 3d electrodes fabricated from TIB2/Graphene/Carbon nanofiber composites in hydrogen evolution reaction" #38 "Reduction of energy costs from groundwater treatment using biochar application in terms of water- #9 "Examining the impact of global climate change on women in energy nexus: Development of energy cost indicator" *Topkapı*	**Global Warming and Environment** Chair: Meltem Vatan #12 "Analyzing fast fashion retailers' efforts to reduce carbon footprint: The case of h&m and lc waikiki" #47 "Planning ports in changing climate - sea level rise and floating ports" #8 "Evaluation of environmental impacts of hydrogen production " #9 "Examining the impact of global climate change on women in terms of health inequity" *Boğaziçi*	**Renewable Energies and Sustainable** Chair: Mohammed Alfatih Salah Hamza Hamid #5 "A comparative study of alternative fuels for reducing marine emissions: Environmental, technical, and economic assessment" #90 "From sunlight to clean energy: harnessing plasmonic Ni nanoparticles and MoS2 for sustainable hydrogen generation in CdXZn1-XS" # 80 "The effects of calsium carbonate on hydrogen technologies: Biomass, water, and fossil fuel" and butyrate production" #1 "Parabolic trough solar collector assisted hydrogen production" *Taksim*	**Renewable Energies and Sustainable** Chair: Secil Pelin Aka #128 "Forecasting wind power generation using machine learning algorithms" #81 "Sustainable Thermal Desalination and Hydrogen Production: An Analysis of a Renewable- Based Energy System from a Thermodynamics Perspective" #95 "Development and analysis of a multi-rotor wind turbine and solar energy-based integrated system for rural electrification" #103 "Performance assessment of a solar and biomass-based energy system having metal hydride-based thermal compressors" *Haliç*
12.00	*Tea Break*			
	Session 25	Session 26	Session 27	Session 28
12.15	**Renewable Energies and Sustainable** Chair: Nader JAVANI #42 "Exergoenvironmental assessment of a high- temperature based geothermal system: A case study" #99 "A geothermal energy-based thermochemical cycle integrated with a cement factory for carbon capture for methane production" #13 "Investigation of the effects of global warming in the Meriç basin with the innovative Şen test" #136 "Experimental investigation and analysis of domestic cooktop burners with different natural gas- hydrogen mixtures" *Topkapı*	**Global Warming and Environment** Chair: Mohammed Alfatih Salah Hamza Hamid #91 "Investigation of the effect of solar radiation on optimum insulation thickness" #106 "Metal organic frameworks loaded membrane for microbial fuel cell application" #113 "A study on global warming effect of Combined Cycle Power Generation Process" #107 "Education on Metaverse Platforms Effects on CO2 Footprint Reduction: Istanbul School of Metaverse Case" Boğaziçi *Boğaziçi*	**Global Warming and Environment** Chair: Adnan Midilli #132 "The role of hydrogen in reducing global warming effects" #117 "Use of the fallout radionuclides technique for soil erosion assessment in northwest Morocco and southwest Türkiye: Comparative study" #49 "General planetary transport system is the tool of non-rocket space industrialization to prevent planetary ecological-resources" #131 "In the quest of decarbonization; combined heat and power versus heat pumps in electrification strategies" Taksim *Taksim*	**Analysis** Chair: Alireza SOURI #126 "TURKEY'S changing roles in the geopolitics of energy transport: A discursive approach" #130 "Thermodynamic analysis of geothermal power plant assisted organic Rankine cycle with ANN approach" #35 "Machine learning-based classification approach for improving renewable energy management in IoT-based smart grids" #41 "Optimal Design and Performance Evaluation of an Off-Grid PV System: A Case Study in Bebel, Iraq" *Haliç*
13.15	**Closing Ceremony & Announcement & Buffet Lunch** *Venue: Topkapı*			

ORAL PROCEEDINGS

SYSTEM DESIGN FOR GREEN POWER GENERATION WITH PIEZOELECTRIC MATERIALS

*Sümeyya Ayca1,2,3 and Sedat Yayla3**
1Faculty of Engineering and Applied Science, Istanbul Health and Technology University, Sutluce, Istanbul, Türkiye
2Faculty of Mechanical Engineering, Yildiz Technical University, Besiktas, Istanbul, Türkiye
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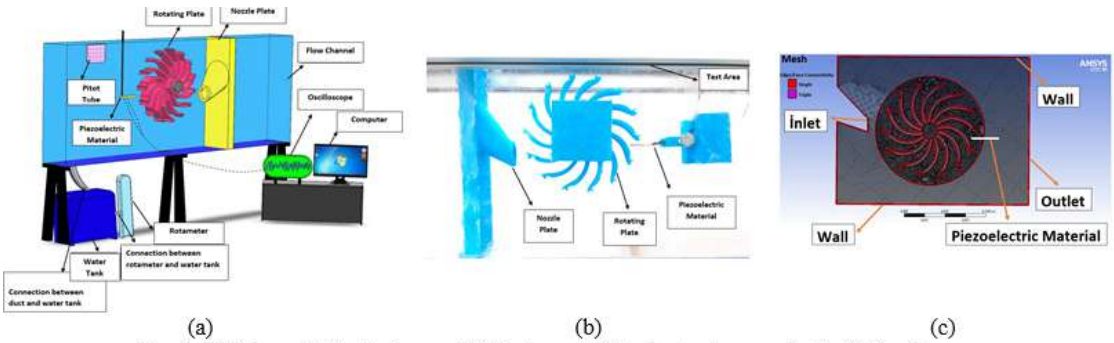
ABSTRACT
In this study; piezoelectric material is used to generate electrical energy within the scope of hydraulic energy, one of the renewable energy sources. In order to increase the electricity generation efficiency of the piezoelectric material used for energy conversion, turbulence intensity was tried to be increased in the existing closed system flow channel and vortex generating plates were designed. In order to establish the boundary conditions, experimental studies were carried out with the first vortex generator plates and then the data obtained with the numerical studies were compared. The number of blades and blade angle of the designed plate were modeled and numerical studies were carried out in ANSYS Fluent program to find the optimum values of the parameters considered. In addition, the optimum distances between the plates, nozzle plate and rotating plate were tried to be found experimentally. The final values obtained as a result of numerical and experimental studies were recorded as 0.019 TKE, 0.28 Volt. Considering the measured results, it was seen that approximately 1.6 times more efficiency TKE and 2.3 times more Volt were obtained than the previous studies.
Keywords: Energy conversion, Vortex generator, Piezoelectric material, Renewable energy.

1. INTRODUCTION
In the developing world, the need for energy is constantly increasing and the tendency towards alternative energy sources to meet this increasing energy need is increasing day by day. With the information age, energy-related developments in technology are progressing in a positive direction (Gross vd, 2003). Progress in technological developments positively affects access to renewable energy sources (Yayla vd, 2020). In addition, clean and renewable energy sources are recognized as the key to life for the future of our world. When the potential of renewable energy sources such as wind, solar, hydraulic (hydroelectric) and hydrogen is examined, it is seen that they are sufficient to meet the required energy demand. In order to generate electrical energy from hydraulic energy, which is a renewable energy source, vortex-based electrical energy generation methods are used. In recent years, the use of piezoelectric materials as generator materials in alternative methods used for electrical energy generation has become widespread. In this study, a series of experimental and numerical studies were carried out within the scope of piezoelectric energy harvesting method (PEH) in order to obtain electrical energy from hydraulic energy, which is a renewable energy source. In the related study, firstly, different plates were designed to increase the vibration on the piezoelectric material. The designed plates were studied numerically and experimentally and optimum values were selected.



(a) (b) (c)

Fig. 1. (a) Schematic illustration and (b) Test area (c) Mesh structure applied in CFD software.

2. SYSTEM DESCRIPTION AND ANALYSIS

The schematic representation of the designed system and the test area are given in Figures 1(a) and 1(b). As shown in Figure 1, piezoelectric materials are used to generate electrical energy and generator plates are used to generate vortices in a recirculating closed system flow channel. ANSSY Fluent program was used for numerical studies and Oscilloscope was used for voltage measurement in experimental studies. In the results obtained, TKE values in numerical studies and Voltage values in experimental studies were compared. Since the length of the nozzle plate was determined as 55mm in the previous study, the length of the nozzle plate was taken constant. In previous studies, the optimum Reynolds Number, and velocity and pressure values of the water flowing in the flow channel were studied and these values were taken as 30825 Re, 1.172 ms-1 and 686 Pa, respectively. In this study, the optimum values of the number of blades and blade angle of the rotating plate were tried to be found by taking the parameters in the previous studies constant. In the ANSYS Fluent program used in numerical studies, k-E model is selected. The number of elements is taken constant as 71702 in this part of the study by making it independent of the mesh in previous studies.

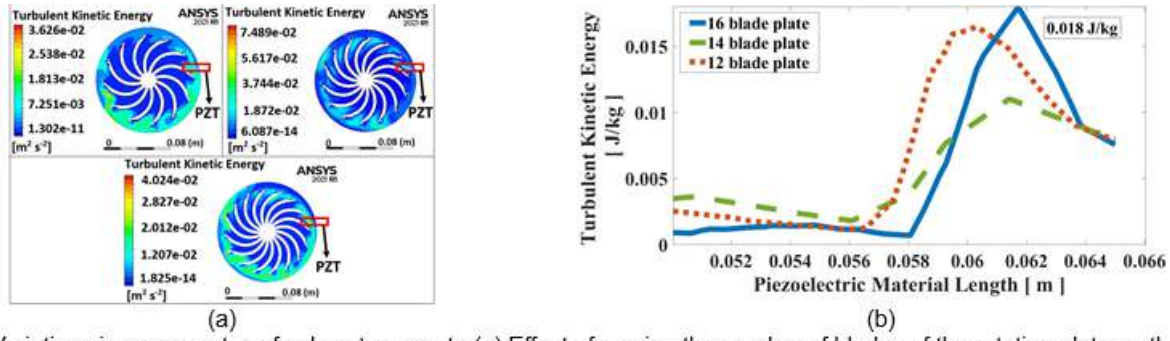


Fig. 2. Variations in exergy rates of subsystems as to (a) Effect of varying the number of blades of the rotating plate on the TKE contour plot, plate with 12, 14 and 16 blades respectively (b) plot of the effect of varying number of blades on Turbulence Kinetic Energy value.

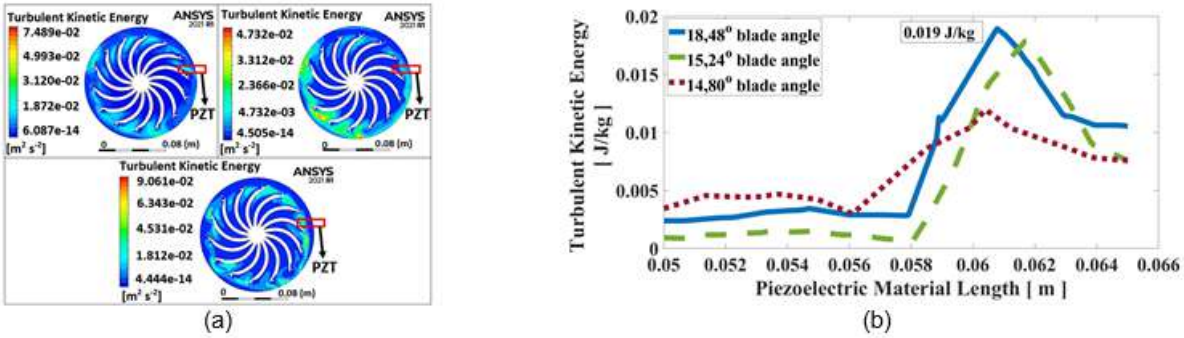


Fig. 3. (a) Effect of changing the wing angle of the rotating plate on the TKE contour plot, 14.80°, 15.24° and 18.48° degrees respectively (b) Plot of the effect of changing wing angle on the Turbulence Kinetic Energy value.

The solid modeling of the varying blade angles is shown in Figure 3 and the number of blades of the rotating plate in the system is fixed in all cases and is considered as 16. The wing angle given in Figure 3 is determined as 14.80°.

4. CONCLUSIONS

A series of experimental and numerical studies have been carried out to increase the efficiency of electricity generated using piezoelectric material. The optimum number of blades of the turbine modeled rotating plate was determined as 16 and the optimum blade angle as 18.48°. The final values obtained as a result of numerical and experimental studies were recorded as 0.019 TKE and 0.28 Volt. Considering the measured results, it was seen that approximately 1.6 times more efficient TKE and 2.3 times more efficient Volt were obtained compared to the previous studies.

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