

# **34th International Conference on Efficiency, Cost, Optimization, Simulation and Environmental Impact of Energy Systems (ECOS 2021)**

Giardini Naxos, Italy  
28 June – 2 July 2021

Volume 1 of 3

ISBN: 978-1-7138-4398-6  
eISBN: 978-1-7138-4393-1

**Printed from e-media with permission by:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571



**Some format issues inherent in the e-media version may also appear in this print version.**

Copyright© (2021) by ECOS 2021 Program Organizers  
All rights reserved.

Printed with permission by Curran Associates, Inc. (2022)

Print ISBN: 978-1-7138-4398-6  
eISBN: 978-1-7138-4393-1

For permission requests, please contact ECOS 2021 Program Organizers  
at the address below.

ECOS 2021 Program Organizers  
Waseda University, 17 Kikui-Cho  
Shinjuku, Tokyo 1620044  
Japan

[ecos2021.org](http://ecos2021.org)

**Additional copies of this publication are available from:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571 USA  
Phone: 845-758-0400  
Fax: 845-758-2633  
Email: [curran@proceedings.com](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)

## Contents

Energy, Exergy, Exergoeconomic and multi-objective optimization of an integrated geothermal trigeneration system Moein Shamoushaki, Lorenzo Talluri, Daniele Fiaschi and Giampaolo Manfrida.....	1
Energy, exergy and exergo-economic assessment of a geothermal power plant with NCGs reinjection Daniele Fiaschi, Giampaolo Manfrida, Moein Shamoushaki and Lorenzo Talluri.....	13
Development of an exergo-economic and exergo-environmental tool for power plant assessment: evaluation of a geothermal case study Daniele Fiaschi, Giampaolo Manfrida, Pietro Ungar and Lorenzo Talluri.....	24
Theoretical Assessment of Binary Mixtures as Working Fluids in Heat Pump Cycles Christoph Höges, Valerius Venzik and Dirk Müller .....	36
Review of model-based transformation scenarios for the Italian electricity system Paula Johanna Thimet and Georgios Mavromatis.....	45
Exergy analysis of an operating biomass thermal power plant José Douglas A. Lira and Waldyr L. R. Gallo .....	57
Simulating uncontrolled and controlled electric vehicle charging loads: temporal and spatial flexibility of demand Christine Gschwendtner and Annegret Stephan.....	70
Energy and exergy analysis of a biomass-fuelled micro-CHP unit Sonja Kallio, Monica Siroux and Stefan-Dominic Voronca.....	86
Life cycle analysis of a carnot battery (Pumped thermal energy storage) Olivier Dumont and Vincent Lemort .....	98
Optimal use of lignocellulosic biomass for the energy transition, including the non-energy demand: the case of the Belgian energy system Martin Colla, Julien Blondeau and Hervé Jeanmart.....	104
Adaptive Rolling Horizon for operational optimization of multi-energy systems Andreas Kämper, Philipp Geers, Ludger Leenders and Andre Bardow .....	116
Trade-offs between productivity, efficiency and costs of biogas plants for agriculture wastes Rafael Nogueira Nakashima and Silvio de Oliveira Junior.....	128
HENDling: Simultaneous Heat-Exchanger-Network Design and Scheduling for Batch Processes Dörthe Franzisca Hoffrogge, Lukas Schulze Balhorn, Hagen Seele, Andreas Kämper and Niklas von der Aßen .....	140
Comprehensive integration of the non-energy demand within a whole-energy system: Towards a defossilisation of the chemical industry in Belgium Xavier Rixhon, Martin Colla, Davide Tonelli, Kevin Verleysen, Gauthier Limpens, Hervé Jeanmart and Francesco Contino.....	152
Exergy, Economic and CO <sub>2</sub> emissions assessment of the ammonia production from residual bagasse gasification for decarbonization purposes Rodrigo Telini, Daniel Florez-Orrego and Silvio Junior .....	164
Evaluating Urban Heat Island mitigation strategies for a Subtropical City Centre (a case study in Osaka, Japan) Tianhong Zheng, Ke Qu and John Kaiser Calautit .....	176
Towards a sustainable supply chain on plastic waste management: multi-criteria optimization approach Rafael Castro-Amoedo, Diya Achi and Maréchal François .....	188
Towards an Integrated Design of Heat Pump Systems: Application and Assessment of Process Intensification using Two-Stage Optimization Christian Vering, Fabian Wüllhorst, Philipp Mehrfeld and Dirk Müller .....	202

Application of artificial intelligence on uncertainty analysis for long-term energy system planning Xiang Li, Dario Müller, Jonas Schnidrig and François Maréchal .....	214
Process synthesis and genetic algorithm-based multi-objective optimization for reduction of topsides dry weight and footprint Leandro Augusto Grandin Pereira and Jurandir Itizo Yanagihara .....	224
Maximum Knowledge Gain through Minimum Number of Experiments: Optimal Experimental Design for Model Evaluation of Heat Pump Compressors Christian Vering, Fabian Wüllhorst, Julian Möntenich, Valerius Venzik and Dirk Müller.....	236
Feasibility of passive solar tracking through the thermal expansion of a PCM medium in a residential TES application: a numerical analysis Barbara Mendecka, Giovanni Di Ilio, Vesselin Krassimirov Krastev and Gino Bella .....	246
Performance simulation of an aeroderivative gas turbine operating at a Brazilian FPSO Rafael Barbosa and Jurandir Yanagihara .....	256
Data reduction for mixed integer linear programming in complex energy systems Luise Middelhauve, Natalija Ljubic, Julia Granacher, Luc Girardin and François Maréchal .....	267
A study on synergies of combined pulp and fuel production Julia Granacher, Erina Clare McDonald, Tuong-Van Nguyen and Francois Maréchal .....	278
Impact of Power-to-X on Energy Systems as a Key Technology to Defossilization Andreas Hanel, Antonia Seibold, Sebastian Fendt and Hartmut Spleithoff .....	289
A game theory based optimal operation strategy for neighborhoods Sarah Henn, Timo Wenzel, Tanja Osterhage and Dirk Müller .....	299
Impact of Parametrization of Battery Energy Storages on Multi-Agent Energy Systems with a High Share of Renewable Energy Sources Jakob Michael Fritz, André Xhonneux and Dirk Müller .....	310
Thermodynamic Analysis of a Falling Film Evaporator Arnat Mahamoudou, Julien Ramousse and Nolwenn Le Pierrès .....	320
Approximate Optimal Control for Heat Pumps in Building Energy Systems Laura Maier, Sarah Henn, Philipp Mehrfeld and Dirk Müller .....	332
Modelling of energy systems with seasonal storage and system state dependent boundary conditions using time series aggregation and segmentation Alexander Holtwerth, André Xhonneux and Dirk Müller .....	344
An exergy-based methodology to determine thermal network's optimal temperature level Yolaine Adihou, Malick Kane, Julien Ramousse and Bernard Souyri .....	355
Impact of Different Forecast Horizons in Energy System Simulations Jerry Lambert, Sebastian Miehling, Stephan Herrmann and Hartmut Spleithoff .....	367
Optimal multi-stage planning of decentralized multi-energy systems considering seasonal energy storage Ivalin Petkov, Christof Knoeri and Georgios Mavromatidis .....	377
Dynamic exergoeconomic analysis of a solar district heating system located in the North West of France Mathilde Veyron, Fabrice Renaude, Daniel Mugnier and Marc Clausse .....	384
System LCOE: applying a whole-energy system to estimate the integration costs of photovoltaic Limpens Gauthier and Hervé Jeanmart .....	396
Flexibility options in a multi-regional whole-energy system: the role of energy carriers in the Italian energy transition Paolo Thiran, Aurélia Hernandez, Gauthier Limpens, Matteo Giacomo Prina, Francesco Contino and Hervé Jeanmart .....	407

## Table of Contents

<p>Tidal current turbine blade optimisation using coupled non-dominated genetic algorithm and blade element momentum theory Eng Jet Yeo, David M. Kennedy and Fergal O'Rourke .....</p> <p>Towards energy efficient planning of Danish cities and neighborhoods Barbara Kristin Holmsund Jepsen, Tom Walther Haut and Muhyiddine Jradi .....</p> <p>An investigation of a hybrid BEM-actuator disk approach in predicting wake development in a RANS-CFD model Chee Meng Pang, David M. Kennedy and Fergal O'rourke .....</p> <p>On the Thermoeconomic Diagnosis through the Localized Physical Exergy Disaggregation for Dissipative Component Isolation Rodrigo Guedes dos Santos, Pedro Rosseto de Faria, Marcelo Aiolfi Barone, Raphael Amorim Lorenzoni, Dimas José Rúa Orozco and José Joaquim Conceição Soares Santos .....</p> <p>Is COVID-19 pandemic a "Black Swan" event? The impact of the pandemic on the Energy Market. Panagiotis Varelas, Francesco Contino and Alessandro Parente .....</p> <p>Dynamic modelling and analysis of novel control strategies for modular cogeneration units operation in hospital facility Francesco Liberato Cappiello and Tobias Gabriel Erhartb .....</p> <p>Dynamic analysis of the heat theft issue for residential buildings Francesco Calise, Francesco Liberato Cappiello, Massimo Dentice D'accadìa and Maria Vicedomini.....</p> <p>Arbitrariness and Waste Cost Treatment of a Cogeneration System with Intercooler and Supplementary Firing Marcelo Aiolfi Barone, Rodrigo Guedes dos Santos, Pedro Rosseto de Faria, Raphael Amorim Lorenzoni, Atílio Barbosa Lourenço and José Joaquim Conceição Soares Santos .....</p> <p>Exergy as a thermodynamic measure of the degree of (un)sustainability of a human society Enrico Sciubba .....</p> <p>Daily and seasonal thermal energy storage for enhanced flexible operation of low-temperature heating and cooling network Andrea Vecchi, Behzad Rismanchi, Pierluigi Mancarella and Adriano Sciacovelli.....</p> <p>Deep-Neural-Network-based Process Data Simulation Model for Production Well of a Geothermal Power Plant Atsuhiro Imagawa, Akira Yoshida and Yoshiharu Amano .....</p> <p>Model Predictive Climate Control of a building based on linear programming Shaojun Huang, Yuming Zhao, Weihan Bao and Christian Veje .....</p> <p>A contribution to the search for a Thermodynamics-based sustainability indicator: Extended Exergy Analysis of the Italian System (1990-2012) and Comparison with other indicators. Alfonso Biondi .....</p> <p>Dynamic Performance Analysis of a Thermochemical Resorption System for Low-grade Heat Storage and Cogeneration of Power and Cold Jonas Parker, Robin Fisher, Elisa Guelpa, Vittorio Verda and Adriano Sciacovelli .....</p> <p>Exergoeconomic analysis of Goswami cycle to exploit medium temperature heat from a geothermal site Martina Leveni, Barbara Mendecka and Raffaello Cozzolino .....</p> <p>Thermodynamic analysis of the fuel spray evaporation process for wet ethanol during the compression stroke of a direct-injection spark-ignition engine Alessandro J. T. B. de Lima and Waldyr L. R. Gallo.....</p> <p>Optimizing Operation of Geothermal Fields using Nonlinear Model Predictive Control and Moving Horizon Estimation Phillip Stoffel, Alexander Kümpel and Dirk Müller .....</p>	<p style="margin-right: 20px;">417</p> <p style="margin-right: 20px;">429</p> <p style="margin-right: 20px;">441</p> <p style="margin-right: 20px;">450</p> <p style="margin-right: 20px;">462</p> <p style="margin-right: 20px;">473</p> <p style="margin-right: 20px;">485</p> <p style="margin-right: 20px;">497</p> <p style="margin-right: 20px;">509</p> <p style="margin-right: 20px;">519</p> <p style="margin-right: 20px;">531</p> <p style="margin-right: 20px;">543</p> <p style="margin-right: 20px;">554</p> <p style="margin-right: 20px;">565</p> <p style="margin-right: 20px;">577</p> <p style="margin-right: 20px;">587</p> <p style="margin-right: 20px;">599</p>
--	--

Optimal design of pathways towards the decarbonization of small islands: The case of Lampedusa Sofia Pavanello, Francesco Baldi, Biagio Di Pietra and Francesco Melino .....	611
Characteristic of the installation for the production of hydrogen powered by renewable photovoltaic energy Karolina Zaik and Sebastian Werle .....	623
An inclusive decision-making approach for selection of comprehensive energy-retrofit combinations in a typical Italian 1960s' multi-family house Ke Qu, Tianhong Zheng, Auwal Muktar Dodo, John Calautit, Saffa Riffat, Xiangjie Chen and Yuhao Wang .....	632
Integration of Advanced Control Methods into Mode-Based Control Logics of Building Energy Systems Laura Maier, Thomas Schreiber, Alexander Kümpel, Philipp Mehrfeld and Dirk Müller .....	644
Thermoeconomics as a cost accounting methodology for Spiral Economy and Industrial Symbiosis Antonio Valero and César Torres .....	656
Thermo- economic analysis of energy saving measures for hospital facilities equipped with trigeneration plants Francesco Calise, Francesco Liberato Cappiello, Massimo Dentice D'accadìa and Maria Vicedomini.....	667
Evaluation of different pumped thermal energy storage systems Josefine Koksharov, Hannah Teles de Oliveira, Frank Dammel and Peter Stephan .....	679
Thermal Energy Storage (TES) to increase flexibility of cogeneration units in District Heating (DH) networks Mosè Rossi, Luca Cioccolanti, Gabriele Comodi, Matteo Lorenzetti, Danilo Salvi and Alessia Arteconi ....	691
Assessing the Contribution of District Heating to the Flexibility of the Italian Power System in High Renewables Penetration Scenarios Chiara Magni, Alessia Arteconi and Sylvain Quoilin.....	703
Offshore utility systems for FPSOs: techno-economic, environmental assessment and trade-offs between gas price, carbon taxation and opportunity cost Daniel Florez-Orrego, Cyro Albuquerque, Julio A.M. Silva, Ronaldo Freire and Silvio Oliveira Junior.....	715
Operational optimization of a 4th generation district heating network using mixed integer quadratically constrained programming Dominik Hering, Michael R. Faller, André Xhonneux and Dirk Müller .....	727
Thermodynamic and Economic Optimization of CO <sub>2</sub> Plume Geothermal Systems for Combined Heat and Power Production Christopher Schiffléchner, Christoph Wieland and Hartmut Spliethoff .....	736
A thermodynamic and technical feasibility study of the subsurface storage of energy in the North Sea abandoned reservoirs Ali Akbar Eftekhari .....	747
Pristinia: A tool for the assessment exergy assessment of topsoil fertility Antonio Valero, Bárbara Palacino, Sonia Ascaso, Sergio Atarés and Alicia Valero .....	760
Navigation and localization of a mobile robot for the charging of electric vehicles Zlatina Dimitrova and Giovanni Juin Gauthier.....	772
Fuel cells as auxiliary power unit for range extender electric vehicles Zlatina Dimitrova and Wissam Bou Nader .....	783
Effects of the sizing scale on the thermoeconomic and environmental performances of heat production systems for a mixed district in France Jaume Fitó, Neha Dimri and Julien Ramousse .....	794
Techno-economical analysis of the mixing of combined heat and power with demand-side management in a local network Timothé Gronier, Erwin Franquet and Stéphane Gibout.....	806

Optimised design of the extension of a district heating network considering demand-side management Timothé Gronier, Jaume Fitó, Erwin Franquet, Stéphane Gibout and Julien Ramousse.....	815
A data-driven based validation and calibration approach to building energy simulation model for accurate pre-retrofit design predictions Ke Qu, Yuhao Wang, Auwal Mukar Dodo, Xiangjie Chen and Saffa Riffat .....	827
Flexible waste heat management and recovery for an electro-intensive industrial process through energy/exergy criteria Sacha Hodencq, Jaume Fitó, François Debray, Benjamin Vincent, Julien Ramousse, Benoit Delinchant and Frédéric Wurtz .....	839
Study and Test of a Post Combustion Chamber for a Recuperative Reheat Stirling Machine Jarosław Jaworski, Jacek Leyko, Grzegorz Mitukiewicz, Jean Bouriot, Willy Pain and Wissam Bou Nader .	851
Energetic and exergetic analysis of solar cooling technology in a low capacity absorption chiller Lucas Barbosa Carneiro, Alex Álisson Bandeira Santos and Antônio Gabriel Souza Almeida .....	863
Mass and heat valorization networks design for eco-industrial parks in non-cooperative schemes. Thibaut Wissocq, Solène Le Bourdiec and Assaad Zoughaib .....	875
Bolivian interconnected power system Marco Navia, Renan Orellana LaFuente, Sergio Luis Balderrama and Sylvain Quoilin.....	886
Experimental analysis of the flow dynamics of multiple jets impinging a non-flat plate Flavia Barbosa, Senhorinha Teixeira and José Carlos Teixeira.....	898
Modelling the energetic performance of a pig stable Willem Faes, Jarissa Maselyne, Michel De Paepe and Steven Lecompte .....	910
Performance maximization of closed-system thermochemical energy storage through reactor design and dynamic operating condition formulation Gabriele Humbert, Yulong Ding and Adriano Sciacovelli .....	916
A modelling framework for assessing the impact of green mobility technologies on energy systems Jonas Schnidrig, Tuong-Van Nguyen, Xiang Li and François Maréchal .....	928
An analysis of the impacts of green mobility strategies and technologies on different European energy systems Tuong-Van Nguyen, Jonas Schnidrig and Francois Marechal .....	941
Holistic modelling and optimisation of thermal load forecasting, heat generation and plant dispatch for a district heating network Matthias Finkenrath, Till Faber, Fabian Behrens and Stefan Leiprecht.....	960
Assessment of the Contribution of Power-To-Hydrogen to the Flexibility of the Future European Energy System Eva Joskin, Matija Pavićević, Chiara Magni and Sylvain Quoilin.....	971
Piston path optimization of Stirling engines Raphael Paul and Karl Heinz Hoffmann .....	983
Exploring the tradeoff between Installed capacity and unserved energy in rural electrification Alejandro Soto, Sergio Balderrama, Evelyn Cardozo, Miguel Fernandez, Jaime Zambrana and Sylvain Quoilin.....	994
Tool for the Optimization of the Sizing and the Outline of District Heating Networks using a Geographic Information System: Application to a Real Case Study Thibaut Résimont, Eva Joskin, Olivier Thomé and Pierre Dewallef.....	1005
Minimizing the unit price of hydrogen production in Power-to-Gas plants by utilizing the Electric Power Exchange Hiroyo Nakazawa, Akira Yoshida, Shin Onodera, Naoki Kemmotsu and Yoshiharu Amano.....	1017

Prediction of Stirling-cycle-based heat pump performance and environmental footprint using exergy analysis and LCA	
Umara Khan, Ron Zevenhoven, Lydia Stougie and Tor-Martin Tveit .....	1029
CFD-aided design of a liquid-to-liquid supercompact disc-shaped heat exchanger: comparison of Fractal, Constructal and EGM configurations	
Enrico Sciubba and Noemi de Martino .....	1041
Thermodynamic analysis of hydrogen production system based on solar energy	
Arif Karabuga, Zafer Utlu and Melik Ziya Yakut .....	1053
Potential of Carnot batteries for load shifting of solar PV-production	
Robin Tassenoy, Kenny Couvreur, Steven Lecompte and Michel De Paepe .....	1063
Thermochemical Energy Storage for Increasing the Flexibility of an Industrial Combined Heat and Power Plant	
Gesa Backofen, Johannes Haimerl, Annelies Vandersickel, Stephan Gleis and Hartmut Spliethoff .....	1074
Long-term operational optimization of a building energy system coupled to a geothermal field	
Alexander Kümpel, Laura Kuper, Phillip Stoffel and Dirk Müller .....	1086
Exploiting the potential of electric vehicle charging combined with a stationary battery within non-residential buildings using hierarchical MPC	
Larissa Kühn, Laura Maier, Philipp Mehrfeld and Dirk Müller .....	1095
Thermogravimetric analysis of thermal degradation of municipal solid waste (MSW) in N <sub>2</sub> , CO <sub>2</sub> and O <sub>2</sub> /CO <sub>2</sub> atmospheres	
Paulina Wienchol, Agnieszka Korus, Andrzej Szlek and Mario Ditaranto .....	1107
Thermodynamic Modeling and Optimization of a Solar-Thermal / Pellet Boiler District Heating Plant Integrating Nanotechnologies	
Eden Mamut, Laurentiu Oancea, Gabriel Prodan, Paul Ivan, Iuliean Hornet .....	1119
Strategies for the decarbonization of a port industrial area: design and operation optimization of a hydrogen hub	
Davide Pivetta, Chiara Dall'Armi and Rodolfo Taccani .....	1127
Extraction energy as a function of ore grade decline: the case of coltan	
Ricardo Magdalena and Alicia Valero .....	1138
Behavior of the specific mining energy with ore grade decline: the case of nickel, cobalt and PGMs	
Ricardo Magdalena, Alicia Valero, Antonio Valero and José Luís Palacios .....	1152
Valorization of Blackcurrant Pomace through Thermochemical Liquefaction in Mixed Solvents	
Mariusz Wądrzyk, Łukasz Korzeniowski, Marek Plata, Rafał Janus, Marek Lewandowski and Przemysław Maziarka .....	1167
Using liquid metals for high energy dissipation	
Gerardo Vargas-Landin, Abel Hernandez-Guerrero, J. Luis Luviano-Ortiz and Yanan Camaraza-Medina ..	1179
Experimental evaluation of a commercially available PEM fuel cell for residential buildings application	
Katarina Simic, Jonas Houf, Wim Beyne, Jan Desmet and Michel De Paepe .....	1189
Numerical and experimental study on 10 kWe metal-halide solar simulator for parabolic-trough collector testing	
Bartosz Stanek and Łukasz Bartela .....	1201
Multi-scale modeling of a shell-and-tube Latent Heat Thermal Storage unit for building-level dynamic simulation	
Alessandro Colangelo, Elisa Guelpa, Andrea Lanzini and Vittorio Verda .....	1213
Thermodynamic analysis of the integrated Power to SNG system using heat from process gas and methanation reactor cooling to produce steam for solid oxide electrolyzer	
Daria Katla, Michał Jurczyk and Anna Skorek-Osikowska .....	1225

## Table of Contents

<p>Conceptual design of a novel hybrid system integrating T-CAES and SOFC-GT Like Zhong, Erren Yao, Hansen Zou and Guang Xi .....</p> <p>Aviation and maritime biofuels production via a combined thermochemical/biochemical pathway: A conceptual design and process simulation study Nikolaos Detsios, Leda Maragoudaki, Konstantinos Atsonios, Ville Nikkanen, Raul Piñero, Jose MÂa Sanz Martín, Karel De Winter, Elodie Vlaeminck, Panagiotis Grammelis and Nikolaos Orfanoudakis .....</p> <p>Analysis of The Energy Consumption Structure and Evaluation of Energy Performance Indicators of The Italian Ceramic Industry Fabrizio Martini, Matteo Ossidi, Marcello Salvio and Claudia Toro.....</p> <p>Hybrid Brayton thermosolar plants at different latitudes and different power scales Judit García Ferrero, Rosa Pilar Merchán Corral, María Jesús Santos Sánchez, Alejandro Medina Domínguez, Antonio González Sánchez and Antonio Calvo Hernández .....</p> <p>Waste heat recovery with high-temperature heat pumps for steam generation: performance and cost effects George Kosmadakis and Panagiotis Neofytou .....</p> <p>Renewable Energy Based Systems with Heat Pumps for Supplying Heating and Cooling in Residential Buildings Marika Pilou, George Kosmadakis, George Meramveliotakis and Achileas Krikas .....</p> <p>Decentralized Forest Biomass Residues Thermal Power Plant Potential: An Economic and Environmental Perspective João Pedro Silva, Ana Cristina Ferreira, Senhorinha Teixeira, José Carlos Teixeira and Bernhard Peters ..</p> <p>Cooling fermentation in the sugar and ethanol production process using an ejector cooling system: Energy usage and impacts on cogeneration system Milagros Cecilia Palacios-Bereche, Reynaldo Palacios-Bereche, Antonio G. Gallego, Carlos Eduardo V. Rossell and Silvia Azucena Nebra .....</p> <p>Energy and exergy assessment of fast pyrolysis of sugarcane straw integrated and non-integrated into the conventional ethanol production process Fernando H. Salina, Milagros Cecilia Palacios-Bereche, Antonio G. Gallego, Reynaldo Palacios-Bereche and Silvia Azucena Nebra .....</p> <p>Use of industrial excess heat to produce district cooling in tropical countries Valentin Salgado Fuentes, Fabian Bühler and Wiebke Brix Markusen.....</p> <p>Thermodynamic analysis of an ejector-assisted ammonia-water absorption-resorption cycle Anil Kumar and Anish Modi .....</p> <p>Thermodynamic analysis of power production based on nitrogen liquefaction cold energy using the cryogenic method Zafer Utlu, Arif Karabuga and Melik Ziya Yakut .....</p> <p>A new approach for estimation of avoidable exergy destruction: A case study of a heat pump unit Volodymyr Voloshchuk, Paride Gullo and Eugene Nikforovich .....</p> <p>Integrated optimal scheduling of direct current distribution systems and direct current driven HVAC in buildings Shaojun Huang, Yuming Zhao, Chao Yang and Christian Veje .....</p> <p>On Board Applications of a Reformed Methanol Fuel Cells Plant Roberto Capata and Asfaw Beyene .....</p> <p>Heat loss analysis in a solar compound parabolic collector with aerogel and polycarbonate cover Manoj Kumar Yadav, Anish Modi and Shireesh B. Kedare .....</p> <p>Influence of Cost Functions on Optimal Design of Heat Pump Systems in Mixed-Integer Linear Programming Hannah Krützfeldt, Christian Vering, Philipp Mehrfeld and Dirk Müller.....</p>	<p>1234</p> <p>1246</p> <p>1258</p> <p>1269</p> <p>1281</p> <p>1293</p> <p>1305</p> <p>1317</p> <p>1329</p> <p>1342</p> <p>1353</p> <p>1364</p> <p>1372</p> <p>1381</p> <p>1393</p> <p>1405</p> <p>1414</p>
---	---

Assessment of Different More Electric and Hybrid-Electric Configurations for Long-Range Multi-Engine Aircraft Felipe Rivabem Gimenez, Carlos Eduardo Keutenedjian Mady and Izabela Batista Henriques .....	1424
Comprehensive Energy and Exergy Analysis of the Ground Source Heat Pump Evaporator Volodymyr Voloshchuk, Olga Kordas and Eugene Nikiforovich .....	1436
District Energy Systems: First Insights from a High-Efficiency Building Case Study in Germany Steffen Lauterbach, Christian Rust, Jakob Hahn and Werner Jensch .....	1446
A General MATLAB Model of Biomass Gasification in a Fluidised Bed Reactor Hamid Rashidi, Aidan Duffy and Wayne Doherty .....	1456
Electrification of the heat supply in the brewing industry through heat pumps Alessandro Mattia, Brian Elmegaard, Riccardo Bergamini, Pernille H. Jørgensen, Stefano Soprani, David Martinez-Maradiaga and Anna Stoppato .....	1467
Numerical analytical study of heat transfer inside the stack of a thermoacoustic device Krzysztof Rogoziński, Grzegorz Nowak, Iwona Nowak and Ryszard Buchalik .....	1479
Exergy analysis as a tool for the rational use of energy in an average house and everyday personal habits Marina Torelli Reis Martins Pereira and Carlos Eduardo Keutenedjian Mady .....	1489
An Exergoeconomic Performance Indicator for Evaluation of Existing Thermal Power Plants Fernando H. Borges Nunes, Nury A. Nieto Garzón and Edson Bazzo .....	1499
Hierarchical Residential Aggregation Method Incorporating Energy Demand Forecast Akira Yoshida, Toranosuke Saito, Takahiro Kashikawa, Koichi Kimura and Yoshiharu Amano .....	1511
Performance investigation of a Closed Greenhouse in a Hot Arid Egyptian Climate Anwar Hegazy, Alison Subiantoro and Stuart Norris .....	1522
Systematic numerical investigation of a high temperature packed bed for energy storage applications Alberto Benato, Francesco De Vanna, Anna Stoppato and Ennio Gallo .....	1532
Performance evaluation of an active PCM cooling application in Northern European climate Viktor Ljungdahl, Muhyiddine Jradi, Christian Veje and Jonathan Dallaire .....	1543
Dynamic modelling of performance and refrigerant charge distribution of a Heat Recovery Ventilation Heat Pump Water Heater Rossana Boccia, Valentin Salgado Fuentes, Jonas K. Jensen, Per Henrik Pedersen and Wiebke B. Markussen .....	1555
Modelling the internal combustion engine waste heat recovery using thermoelectric modules Ryszard Buchalik, Grzegorz Nowak and Krzysztof Rogozinski .....	1567
Dynamic Modelling of a Free Liquid Piston Ericsson Engine (FLPEE) Ryma Chouder, Pascal Stouffs and Azzedine Benabdesselam .....	1579
Development of a Dynamic Multi-Sector Energy Economic Model to Analyse Primary Energy Supply and Optimum Electricity Generation Mix of Bangladesh Jubair Sieed, Ryoichi Komiya and Yasumasa Fujii .....	1591
Replacing natural gas with renewable hydrogen in combined heat and power plants Efthymia Ioanna Koytsoumpa, Sotirios Karella and Aggelos Doukelis .....	1603
Integrated organic Rankine cycle (ORC) and heat pump (HP) systems for domestic heating Jian Song, Andreas Olympios, Matthias Mersch, Paul Sapin and Christos Markides .....	1615
Design considerations and numerical simulations of variable thickness scroll geometries Ettore Fadiga, Nicola Casari, Alessio Suman, Michele Pinelli and Francesco Montomoli .....	1626
Numerical study of a centrifugal pump using Harmonic Balance Method in OpenFOAM Stefano Oliani, Nicola Casari, Michele Pinelli, Alessio Suman and Mauro Carnevale .....	1637

Efficiency Improvement of a Solid Oxide Fuel Cell System Fueled with Ammonia Kalimuthu Selvam, Yosuke Komatsu, Anna Sciazko, Shozo Kaneko and Naoki Shikazono .....	1647
Multi-objective optimization of organic Rankine cycle systems considering their dynamic performance Roberto Pili, Søren Bojer Jørgensen and Fredrik Haglind.....	1659
Dynamic modelling and energy analysis of offshore compressed air storage in the North Sea region Ali Akbar Eftekhari and Negar Khoshnevis Gargar .....	1671
Comparison of three power-to-X storage solutions for the path of decarbonization: Germany as a case study Jimena Incer Valverde, Laura J. Patiño Arévalo, Tatiana Morosuk and Geroge Tsatsaronis .....	1679
Development of an Advanced Monitoring Application for the Power and Efficiency of Air-cooled Geothermal Power Plants Matthäus Irl, Christoph Wieland and Hartmut Spliethoff.....	1692
Integration of pumped thermal energy storage systems based on Brayton cycle with CSP plants Mario Petrollese, Mario Cascetta, Giorgio Cau, Vittorio Tola and Daniele Cocco .....	1704
Assessment of exergetic efficiency of cities evaluating effects of municipal solid waste mixing entropy Ricardo Hartmann and Luis Evelio Garcia-Acevedo .....	1716
Use of ultrasonic technology for the maximization of gas concentration in gas-liquid mixtures Marco Ballarin, Anna Stoppato, Alberto Benato, Pietrogiovanni Cerchier and Graziano Tassinato .....	1729
Field-test economic and ecological performance of Proton Exchange Membrane Fuel Cells (PEMFC) used in residential micro-combined heat and power applications (micro-CHP) Nicolas Paulus, Camila Davila and Vincent Lemort .....	1739
Green hydrogen from wind energy: mitigation of operating point fluctuations Angelica Liponi, Guido Francesco Frate, Andrea Baccioli, Lorenzo Ferrari and Umberto Desideri .....	1751
Development of Neural Networks for Remote Monitoring of Energy Consumption In Telecommunication Sites Francesco Nastro, Marco Sorrentino and Alena Trifirò .....	1763
Waste Heat Recovery from Algerian cement industries: SRC and ORC thermodynamic optimization, and economic and environmental factors Yousef Redjeb, Anna Stoppato, Alberto Benato and Khatima Kaabeche-Djerifi .....	1771
Performance evaluation of different Low Temperature A-CAES configurations Vittorio Tola, Francesca Carolina Marcello, Giorgio Cau and Daniele Cocco.....	1783
Increasing the efficiency of the parabolic trough collector under variable solar irradiance by internal flow turbulization - a numerical study Krzysztof Grzywnowicz, Bartosz Stanek and Łukasz Bartela .....	1795
The challenge of reducing supply temperature in existing district heating networks Elisa Guelpa, Martina Capone and Vittorio Verda.....	1810
Numerical assessment of increasing photovoltaic self-sufficiency of a low energy residential building in Belgium by using heat pump and energy storage Katarina Simic, Klaas Thiers, Hugo Monteyne, Jan Desmet and Michel De Paepe .....	1820
3D heat transport system for prismatic battery pack Roman Gozdur, Bartłomiej Guzowski, Zlatina Dimitrova and Marco Simonetti .....	1832
Operational challenges in large-scale ammonia heat pump systems José Joaquín Aguilera, Wiebke Meesenburg, Torben Ommen, Jonas Lundsted Poulsen, Kenneth Rugholm Kramer, Wiebke Brix Markussen, Benjamin Zühlisdorf and Brian Elmegaard.....	1842
Automatic digital twin generation of building energy systems using piping and instrumentation diagrams Florian Stinner, Martin Wiecek, Marc Baranski, Alexander Kümpel and Dirk Müller.....	1854

Integration of prosumers in high temperature and low temperature district heating networks Vittorio Verda, Elisa Guelpa and Giulia Mancò .....	1866
Design and construction challenges for a hybrid air and thermal energy storage system built in the post-mining shaft Sebastian Waniczek, Łukasz Bartela, Marcin Lutyński, Sebastian Rulik, Michał Brzuszkiewicz, Konrad Kołodziej, Jakub Ochmann, Grzegorz Smolnik, Michał Jurczyk and Marian Lipka .....	1873
Integration of CO <sub>2</sub> adsorption capture unit with flue gas conditioning by absorption chiller Dariusz Wawryńczak, Marcin Panowski and Izabela Majchrzak-Kucęba .....	1885
Comparing Efficiencies of Converting Excess Electricity and Biomass to Hydrogen and other Synthetic Fuels Sebastian Miehling, Sebastian Fendt and Hartmut Spleithoff .....	1893
Efficiency trade-offs in the Brazilian passenger vehicle fleet Rafael Mosquim and Carlos Eduardo Mady .....	1902
Part load operation analysis of a biomass steam generator integrated with a concentrated solar power plant Álvaro Adolfo Díaz Pérez, Eduardo Konrad Burin and Edson Bazzo .....	1913
Energy and Exergy Performance Evaluation of a Solar-Biomass Hybrid Cogeneration Cycle Applied to the Corn Ethanol Industry Lauro Augusto J. Oliveira, Eduardo K. Burin and Edson Bazzo .....	1924
Challenges of working with a large building energy database. Combining datasets from different scales Javier Urquiza, Carlos Calderon and Philip James .....	1934
Solar-thermal heating potential in the UK: A techno-economic whole-energy system analysis Matthias Mersch, Andreas Olympios, Paul Sapin, Niall Mac Dowell and Christos N. Markides .....	1946
Sustainable and resilient energy development status (2021), as affected and revealed by the pandemic Noam Lior .....	1958
The role of the Thermoeconomic Environment in the exergy based cost accounting of technological and biological systems Melchiorre Casisi, Sobhy Khedr and Mauro Reini .....	1970
Feasibility of Thermally Infused Water Hammer for Dual Application Ashenafi Abebe Mebrat, Yilma Tadesse and Asfaw Beyene .....	1982
Simulation, optimization and design of a heating network at an industrial plant Elias Vieren, Kenny Couvreur, Judith Vander Heyde, Michel De Paepe and Steven Lecompte .....	1988
CFD-assisted design of an improved hybrid turbocompound system for a light urban vehicle Tania Silvestri, Nicolò Cuturi and Enrico Sciubba .....	2000
Effect of temporal resolution on long-term power system planning modelling Anastasia Ioannou .....	2011
Assessment of the thermodynamic rarity of Mobile Phones PCBs Jorge Torrubia, Antonio Valero and Alicia Valero .....	2022
Experimental Heat Transfer Study Using Liquid Crystals on a Swirl Cooling Flow Circular Chamber with and without Elbow Daisy Galeana and Asfaw Beyene .....	2034
New incentive systems for renewable penetration considering local climatic characteristics and sources availability: the case of Italy Gennaro Vitiello, Gianluca Carraro, Sergio Rech, Andrea Lazzaretto and Piero Danieli .....	2043
How to Reduce the Design of Disc-Shaped Heat Exchangers to a Zero-Degrees-of-Freedom Task Enrico Sciubba .....	2057

Table of Contents

Possibilities of using molten boron compounds as electrolyte for medium temperature fuel cells Jaroslaw Milewski, Arkadiusz Szczesniak, Lukasz Szablowski, Alexander Martinchik, Maciej Siekierski and Konrad Swirski .....	2069
A numerical analysis of the temperature field evolution during an optimization of the catalyst distribution in a steam reforming reactor Marcin Pajak, Shinji Kimijima and Janusz Szmyd.....	2078
Comparative analysis of aggregate battery models to characterize the flexibility of electric water heaters Louis Brouyaux, Pol Olivella-Rosell, Sandro Iacobella and Sylvain Quoilin .....	2089
A critical assessment of three possible exergy-based sustainability indicators Enrico Sciubba .....	2099
Absorption-based carbon capture energy penalty reduction for micro gas turbine application: pre-assessment of the impact of appropriate amine solvent and process selection (final version) Antoine Verhaeghe, Lionel Dubois, Laurent Bricteux, Diane Thomas and Ward De Paepe.....	2111