## FRANO BARBIR, Ph.D.

Professor Emeritus, Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture University of Split, R Boskovica 32, 21000 Split, Croatia Tel. +385-91-4305-953; E-mail: <u>fbarbir@fesb.hr</u>;

# SUMMARY

- Held technical and managerial positions with major fuel cell/electrolyzer companies.
- Proven track record in PEM fuel cell stack and system development developed working fuel cell stacks and systems, 9 fuel cells/electrolyzer related patents).
- Program Manager/Principal Investigator on multi-million dollar R&D projects
- Introduced and taught Fuel Cell Engineering course at several universities in U.S. and abroad.
- Author of the book *PEM Fuel Cells: Theory and Practice*, Elsevier/Academic Press, 2<sup>nd</sup> ed. 2013. The book has been translated to Chinese, Korean and Farsi.
- More than 300 publications in technical and scientific journals, books, encyclopedia, and conference proceedings; more than 7000 citations; h-index 36
- Founding President of the Croatian Hydrogen Association.

# EDUCATION

- **Ph.D.** in Mechanical Engineering, Thermal and Fluid Sciences Program, specialized in Hydrogen Energy Systems, University of Miami, Coral Gables, Florida, 1992.
- **M.Sc.** in Chemical Engineering, Ecological Engineering Program, Zagreb University, Zagreb, Croatia, 1984.
- **Dipl.-Ing.** in Mechanical Engineering, Thermotechnical Engineering Program, Zagreb University, Zagreb, Croatia, 1978.

# **EMPLOYMENT HISTORY**

- Professor Emeritus/Project Activity Leader (since 2020)
  - Project LUMINIH2 Laboratory model and prototype of a control and monitoring system for micro-grids with renewable energy sources and hydrogen technologies (January 2024 – )
  - Project R&D of control algorithms for electrolyzer operation with highly variable input currents, (December 2023 )
  - Project STIM-REI, Project Activity IC: R&D on fuel cells and electrolyzers, Center of Excellence for Science and Technology – Integration of Mediterranean Region (STIM), University of Split, Croatia (October 2017 – November 2023)
- **Professor**, Chair for thermodynamics, Head of Laboratory for New Thermo-Energy Technologies, Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, University of Split, Croatia, (October 2006 September 2020)
- Academic Professional Lecturer at the rank of Associate in the Department of Mechanical Engineering, University of Wyoming, Laramie, WY, U.S.A. (Spring semesters 2012 & 2013)

- Associate Director for Science & Technology, United Nations Industrial Development Organization – International Centre for Hydrogen Energy Technologies (UNIDO-ICHET), Istanbul, Turkey (July 2005 – January 2008)
- **Professor in Residence**, dual position at Connecticut Global Fuel Cell Center and Mechanical Engineering Department, University of Connecticut, Storrs, CT (October 2003 August 2005)
- **Director of Fuel Cell Technology, Director of R&D and Chief Scientist**, Proton Energy Systems, Wallingford, CT (August 2001 October 2003)
- Vice President, Technology and Chief Scientist, Energy Partners, West Palm Beach, Florida 1999-2001
- Principal Research Engineer, Energy Partners, West Palm Beach, Florida 1992-1999
- **Research Fellow,** Clean Energy Research Institute, University of Miami, Coral Gables, Florida, 1989-1999
- **Research Engineer**, Institute of Shipbuilding Industry, New Products Department, Split, Croatia 1985-1988
- Project Engineer, Project Office Termofriz, Split, Croatia 1978-1985

# **PROFESSIONAL/CONSULTING ACTIVITIES**

- Consultant/Interim Director, Hydrogen South Africa, Catalysis Center of Competence, University of Cape Town, Cape Town, South Africa (2010-2011)
- Senior Consultant, United Nations Industrial Development Organization International Centre for Hydrogen Energy Technologies (UNIDO-ICHET), Istanbul, Turkey (2008-2011)
- Consultant for new energy technologies, Split-Dalmatian County, participant in the EU Intelligent Energy Europe Project: Energy Actions and Systems for Mediterranean Local Communities (EASY) (2008-2009)
- International Consultant and Reviewer, participated in creation of the National Hydrogen and Fuel Cell Technologies Research, Development and Innovation Strategy, Department of Science and Technology, Republic of South Africa (2006-2007)
- Technical Advisor, Earthrise Capital, New York, (since 2008)
- Consultant United Nations Development Programme (UNDP), Brazil (1998) participated in GEF/UNDP Project on Fuel Cell Buses for Brazil.
- Consultant Energy Institute "Hrvoje Pozar", Zagreb, Croatia (1997-98) participated in Strategy of Energy Development of the Republic of Croatia, and National Energy Programs.

# **COMMITTEES AND BOARDS**

- Member, HySA Systems Advisory Board, HySA Systems Centre of Competence, University of Western Cape, Bellville, Cape Town, South Africa (since 2024)
- Representative of Croatia in States Representatives Group, Clean Hydrogen Partnership (2022-2024)
- Chairman, States Representatives Group (representing Croatia), Fuel Cell and Hydrogen Joint Undertaking 2 (member 2015-2021; Chairman 2017-2021)

- Member, Expert Working Group for Croatian National Hydrogen Strategy, Ministry of Economy and Sustainable Development (2021)
- Member, International Scientific Advisory Board, Africa Centre of Excellence in Future Energies and Electrochemical Systems (ACE-FUELS), Federal University of Technology, Owerri, Nigeria (since 2019)
- Member, National Board for Science, Higher Education and Technological Development (2014 2016)
- Member of the Board of Directors, BICRO Croatian National Agency for Business and Innovations (2012–2013)
- Member, Science Awards Committee, Croatian National Parliament (2012 2016)
- Member of the Council for National Innovation System, Republic of Croatia (2008-2010)
- Member of the Board of Directors, International Association for Hydrogen Energy (2008 )
- Chairman, Awards Committee, International Association for Hydrogen Energy, (1997-2010)
- Member, Policy Advisory Board, Florida Solar Energy Center, Cape Canaveral, Florida (1996-2006)
- Member, Technical Advisory Board, Franklin Fuel Cells, Wayne, PA (2002-2004)

### **MEMBERSHIPS**

- Croatian Hydrogen Association (Founder and President since 2019); Croatian Association for Hydrogen Energy (Founder and President 2007-2019)
- Croatian Pugwash Society (member since 2021)
- Member of the Croatian Academy of Technical Sciences (member since 2015)
- International Association for Hydrogen Energy (IAHE) (Member since 1992; Fellow since 2014, Vice-President 2019-2024, Executive Vice-President 2024 –
- Croatian professional-scientific association for energy, mechanical engineering technologies and renewable energy sources (member since 2010)
- The Electrochemical Society (member since 1994)

## AWARDS, HONORS

- City of Split Award for lifetime achievements, 2025
- Croatian National Science Award for lifetime achievement in technical sciences, 2020
- University of Split Science Award, 2020
- Award Hrvoje Pozar by Croatian Energy Society for exceptional contribution to energetics, 2016
- Croatian Annual National Science Award for technical sciences, 2012
- University of Split Recognition Plaque for exceptional contribution to development of University through outstanding scientific educational and professional work, 2012

### **EDITORIAL ACTIVITIES**

- Associate Editor *International Journal of Hydrogen Energy*, Elsevier Science, (1997 2010); Editor Emeritus (since 2010)
- Member of the Scientific and Editorial Committee, *International Journal of Nuclear Hydrogen Production and Applications*, Inderscience Publishers (2004 – present)
- Member of the Editoral Board, EGE, EnergetikaMarketing, Zagreb, (1997 present)
- Member of the Consulting Editorial Board, *Encyclopedia of Life Support Systems*, D.A.K. Al Gobaisi (ed.), EOLSS, London, (1995-96)

## **ORGANIZATIONS OF CONFERENCES AND WORKSHOPS**

- Co-Organizer, Conference on Hydrogen Safety, Agency for Hydrocarbons and Croatian Hydrogen Association, Zagreb, 03.04.2025.
- Organizer and Chair, Conference on alternative propulsion for railroad vehicles, Croatian Hydrogen Association and Croatian Society of Railroad Engineers, Zagreb 21.09.2023.
- Organizer, International Webinar on Hydrogen in Energy Transition, on behalf of the Section on Energy Systems of the Croatian Academy of Technical Sciences, and Croatian Hydrogen Association, 05. March 2021.
- Organizer, Low or Zero Emissions Mobility, Day 4 at Sustainable Energy Week, Split-Dalmatian County, FESB and University Department of Professional Studies, Split, 7 July 2018
- Chairman, European Fuel Cell Forum 2015, Lucerne, Switzerland 28 June 1 July
- Organizer, Short-Course and Workshop PEM Fuel Cell Catalyst and MEA Preparation and Characterisation, University of Cape Town, South Africa, 28-29 March, 2011.
- Co-Director, NATO Advanced Research Workshop, Energy Options Impact on Regional Security, Split, Croatia, 17-20 June 2009.
- Organizer and Chair, International Conference Hydrogen on Islands, Bol, Croatia, 22-24. October, 2008.
- Organizer and Chair, Hydrogen Islands, special session at 17<sup>th</sup> World Hydrogen Energy Conference, Brisbane, Australia, 15-19 June 2008.
- Organizer and Moderator, Panel Session "How Hydrogen Can Contribute to Meeting the Challenges of Climate Change and Energy", side event at UN ECOSOC, New York, 2. July, 2008
- Organizer and Chair, Hydrogen Islands Initiative, kick-off meeting, side event at RERINA Integration of Renewable Energy Technologies in Rural Insular Areas European Conference, Brussels, Belgium, 9-11 October, 2007.
- Co-Director, NATO Advanced Research Workshop on Sustainable Energy Production and Consumption and Environmental Costing, University of Naples, Naples, Italy, 4.-7. July 2007.
- Organizer and Moderator, Panel Session "Hydrogen Activities Around the World", side Event at UNIDO General Conference, Vienna, Austria, 3-7 December, 2007.

• Director, Expert Group Meeting on Development of advanced materials for hydrogen storage applications, UNIDO-ICHET, Istanbul, Turkey, 6.-7. April 2007.

## TEACHING

### At University of Rijeka (2024)

Graduate level

• Hydrogen Technologies in Shipping

### At University of Split (2006 – 2020)

Undergraduate level

- Thermodynamics
- Measurements in Engineering (Thermal and Fluids)

Graduate level

- Heat and Mass Transfer
- Renewable Energy Sources and Sustainable Development
- Thermal Power Plants
- Fuel Cells
- Modeling of Processes in Fuel Cells
- Experimental Methods

### At University of Wyoming (2012-2013)

Undergraduate level

- Special Topics in Mechanical Engineering: Fuel Cells Engineering (Spring semester 2013) Graduate level
- Special Topics in Mechanical Engineering: Fuel Cell Modeling (Spring semester 2012)

## **At University of Connecticut**

Undergraduate/graduate level

• Special Topics in Mechanical Engineering: Fuel Cells Engineering (2002 - 2005)

## **At University of Miami**

Undergraduate level

• Energy Conversion (1998)

Graduate level

• Intermediate Fluid Mechanics (1992)

## **MENTORING OF PhD STUDENTS**

- Ivan Tolj, FESB University of Split, graduated 2012
- Dario Bezmalinović, FESB University of Split, graduated 2015
- Željko Penga, FESB University of Split, graduated 2017
- Ivan Pivac, FESB University of Split, graduated in 2018
- Ivan Poljak, FESB University of Split, graduated in 2022 (co-mentor)
- Domina Cikatić Šanić, FESB University of Split, graduated in 2023

- Frane Martinić, FESB University of Split, graduated in 2023
- Andrej Zvonimir Tomić, FESB University of Split, graduated in 2024
- Anamarija Stoilova, Faculty of Chemical Technology, University of Split, current (co-mentor)
- Boris Delipetar, FESB University of Split, current (co-mentor)

## ESTABLISHED FUEL CELL TESTING LABORATORIES

- Energy Partners, West Palm Beach, FL, USA (1998-1999)
- Proton Energy Systems, Wallingford, CT, USA (2001-2003)
- Global Connecticut Fuel Cell Center, University of Connecticut, Storrs, CT, USA (2003-2005)
- United Nations Industrial Development Organization International Center for Hydrogen Energy Technologies, UNIDO-ICHET, Istanbul, Turkey (2006-2008)
- Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture (FESB) University of Split (2006-2008)
- Center of Excellence for Science and Technology Integration of Mediterranean Region (STIM) University of Split (2017-2019)

# **R&D PROJECTS**

### **Projects with Croatian Hydrogen Association**

- Participant/Task leader, Zero Emission Adriatic Ship (ZEAS), EC Zero Emission Waterborne Transport Partnership (HorizonEurope), 2024-2028
- Coordinator for Croatia, JIVE2 Central & Eastern Europe Bus Roadshow, EC Clean Hydrogen Partnership, 2022

## **Projects with University of Split**

- Project leader, Key technologies for hydrogen and fuel cells for China-Croatia pantransportation applications, Bi-lateral China-Croatia project collaboration with Tongji University, Shanghai, China; Funded by the Ministry of Science and Education (2025-2026)
- Participant/Task leader, Laboratory model and prototype of a control and monitoring system for micro-grids with renewable energy sources and hydrogen technologies LUMINIH2. Collaboration with Končar Institute for Electrical Engineering, Funded by the Ministry of Science and Education (2024-2027)
- Participant, Electrochemical compression of hydrogen using a PEM fuel cell with adjusted operating conditions. Funded by the Ministry of Science and Education through the National Recovery and Resilience Plan (2024-2025)
- Project leader, Experimental investigation of electrochemical hydrogen compressor performance and degradation. Funded by Atlas Copco Airpower NV Airtec Division, Belgium (2023-2024)
- Participant/Associate partner, North Adriatic Hydrogen Valley NAHV, EC Clean Hydrogen Partnership (HorizonEurope), 2023-2029
- Project leader, R&D of control algorithms for electrolyzer operation with highly variable input currents, Funded by the Croatian Fund for Environmental Protection and Energy Efficiency, 2023-2025

- Research Activity Leader: STIM-REI, Center of Excellence for Science and Technology Integration of Mediterranean Region, EU Structural Funds (ERDF) through Central Financing and Contracting Agency (SAFU), 2017-2022
- Work Package Leader: Giantleap, EC FCH Joint Undertaking (Horizon 2020), 2016-2019
- Work Package Leader: Automotive Derivative Energy System (AutoRE), EC FCH Joint Undertaking (Horizon 2020), 2015-2018
- Principal Investigator: Water and Heat Management and Durability of PEM Fuel Cells, Croatian Science Foundation, 2014-2018
- Project Leader: Research and Development of Hydrogen Energy System in Conjunction with Renewable Energy Sources, EU Structural Funds (ERDF) through Central Financing and Contracting Agency (SAFU), 2014-2016
- Work Package Leader: System Automation of PEMFCs with Prognostics and Health management for Improved Reliability and Economy (SAPPHIRE) EC FCH Joint Undertaking (FP7), 2013-2016
- Work Package Leader: Development of Guidance Manual for LCA Application to Fuel Cells and Hydrogen technologies (HyGuide), EC FCH Joint Undertaking (FP7), 2010-2011
- Principal Investigator: Passive fuel cells with oxygen supply from air by natural convection, Croatian Ministry of Science, Education and Sports, 2007-2013
- Grant Recipient: Fuel cell stack thermal behavior, EU Marie Curie International Reintegration Grant, 2007-2009
- Grant Recipient: Investigation of operating parameters and flow field design on performance of PEM fuel cell, Croatian Foundation for Science, 2007-2008

## **Projects with UNIDO-ICHET**

• Participant: NANOCOFC Enhancement of Research Capabilities on Multi-Functional Nanocomposites for Advanced Fuel Cell Technology through EU-Turkish-China Cooperation, EC FP6, 2006-07

## **Projects with Connecticut Global Fuel Cell Center**

- Principal Investigator: PEM Fuel Cell for Navy Torpedo Applications, Design by Analysis, Inc. 2005
- Technical Program Manager: Micro/miniature fuel cells for portable applications (Phase II and III) U.S.Army, RDECOM, 2003-2005
- Principal Investigator: Comparison of PEMFC internal resistance measurement techniques, Lynntech Inc., 2004

## **Projects with Proton Energy Systems, Wallingford, CT**

- Task Leader: Development and Demonstration of Fuel Cell Back-up Power System, Development of Fuel Cell Stack, Connecticut Clean Energy Fund, 2003
- Principal Investigator: Lightweight Unitized Regenerative Fuel Cell, NASA/SBIR Phase I, 2003
- Principal Investigator: Lightweight Hardware Design for Regenerative Fuel Cells, DOD/MDA SBIR Phase I, 2003

### **Projects with Energy Partners, West Palm Beach, FL**

- Principal Investigator: High Performance, Matching PEM Fuel Cell Components and Integrated Pilot Manufacturing Process, 3M Company/ Department of Energy, 1999-2001
- Principal Investigator: High Performance, Low Cost Membrane Electrode Assemblies for PEM Fuel Cells, 3M Company/ Department of Energy, 1998-1999
- Program Co-Manager: Development and Delivery of a 20 kW PEM Fuel Cell Stack, Virginia Tech/U.S. Department of Energy, Future Car Challenge, 1999
- Co-Principal Investigator: Development of Advanced, Low Cost PEM Fuel Cell Stack and System Design for Operation on Reformate Used in Vehicle Power Systems, PRDA/U.S. Department of Energy Office of Transportation Technologies, 1997-2001
- Principal Investigator: Development of Integrated Renewable Hydrogen Utility System, U.S. Department of Energy/Hydrogen Program, 1998
- Principal Investigator: Development of Advanced PEM Fuel Cell for Transportation, PRDA/U.S. Department of Energy Office of Transportation Tech. 1996-98
- Principal Investigator: R&D of Direct Hydrogen PEM Fuel Cell for Transportation Applications, Ford Motor Company/ U.S. Department of Energy, 1995-96
- Principal Investigator: Electrostatic Deposition of Catalyst on a Polymer Membrane for Fuel Cell Applications, National Science Foundation/SBIR Phase I, 1995
- Principal Investigator: Development of an Air-Open PEM Fuel Cell, Department of Defense/U.S. Army Research Laboratory/ SBIR Phase I, 1995
- Principal Investigator: US Hybrid Propulsion System Development, Ford Motor Company/ Department of Energy, 1994-95

# STUDIES, ANALYSES, ELABORATES

- Key expert/Consultant, Study on Greening of Croatian motorways Integration of Solar PV -EV Charging and H2 refuelling, Energy Institute Hrvoje Požar/Stantec for HAC, funded by european Investment Bank Advisory Services (2024-25)
- Key expert, Study of the development plan and implementation of the Croatian Hydrogen Strategy by 2050, Ekonerg d.o.o. Zagreb for Agency for Hydrocarbons (July 2024)
- Project leader, Techno-economic analysis of profitability of investments in electrolyzer plant for hydrogen production and stationary battery storage within the scope of the solar power plants in Dalmatia owned by Petrol Group. FESB for TEC/Petrol Group (June 2024)
- Consultant, Prefeasibility study on installation of a battery system and electrolyzer at KTE Jertovec, Energy Institute Hrvoje Pozar for HEP (December 2021)
- Project leader, Prefeasibility study on installation of an electrolyzer in the Oil refinery Rijeka, INA (November 2021)
- Project leader, Study on Electrochemical Hydrogen Compressor technology overview, FESB for Airtec Division, AtlasCopco (September 2021)
- Project leader, Prefeasibility study on hydrogen refuelling station, FESB for HEP (August 2020)

- Author, Study on Future of Hydrogen, for United Nations Industrial Development Organization – International Center for Hydrogen Energy Technologies, UNIDO-ICHET, Istanbul, Turkey, (October 2010)
- Co-Author, Study on Hydrogen Fuel Cell Buses for Brazil: Environmental Benefits, for United Nations Development Programme (UNDP), project no. BRA/97/G41 financed by Global Environment Facility (GEF) and UNDP (September 1998)

## PUBLICATIONS

### Books

- 1. F. Barbir, *PEM Fuel Cells: Theory and Practice*, 2<sup>nd</sup> updated and enlarged edition, Elsevier/Academic Press, Burlington, 2013. (ISBN 978-0-12-387710-9)
- 2. T.N. Veziroglu and F. Barbir, *Hydrogen Energy Technologies*, UNIDO Emerging Technologies Series, United Nations Industrial Development Organisation, Vienna, Austria, 1998.

## **Edited Books**

- P. Das, K. Jiao, Y. Wang, F. Barbir, X. Li, (Eds.), Fuel Cells for Transportation: Fundamental Principles and Applications, Elsevier/Woodhead Publishing, 2023. (ISBN 978-0-32399-485-9)
- F. Barbir, A. Basile, T.N. Veziroglu, (Eds.), Compendium of Hydrogen Energy, Vol. 3 Hydrogen Energy Conversion, Elsevier/Woodhead Publishing, 2015. (ISBN 978-1-78242-363-8)
- 3. F. Barbir and S. Ulgiati, (Eds.), *Energy Options Impact on Regional Security*, NATO Science for Peace Series, Springer Verlag, Dordrecht, NL, 2010. (ISBN 978-9048195640)
- 4. F. Barbir and S. Ulgiati, (Eds.), *Sustainable Energy Production and Consumption: Benefits, Strategies and Environmental Costing*, NATO Science for Peace Series, Springer Verlag, Dordrecht, NL, 2008. (ISBN 978-1-4020-8492-8).

# **Chapters in Books and Encyclopedias:**

- 1. F. Barbir, Primjena elektrokemijskog kompresora za recirkulaciju vodika u gorivnom članku, godišnjak Hrvatske akademije tehničkih znanosti, HATZ (2019)
- F. Barbir, Hydrogen Islands Utilization of Renewable Energy for an Autonomous Power Supply, in D. Stolten and B. Emonts, (Eds.), Hydrogen Science and Engineering: Materials, Processes, Systems, and Technology, Viley-VCH, 2015 pp.1075-1098
- 3. F. Barbir, Regenerative Fuel Cells, in J. Garche, C. Dyer, P. Moseley, Z. Ogumi, D. Rand and B. Scrosati (Eds.), Encyclopedia of Electrochemical Power Sources, Vol 3. Elsevier, Amsterdam, 2009. pp. 224–237.
- F. Barbir, International Association for Hydrogen Energy, in C. Tietje and A. Brouder (Eds.) Handbook on Transnational Economic Governance Regimes, Brill Academic Publishing, Leiden, (ISBN: 978-90-04-16330-0) 2009. pp. 915-921
- 5. F. Barbir, Fuel Cell Basic Chemistry, Electrochemistry and Thermodynamics, in S. Kakac, A. Pramuanjaroenkij, L. Vasiliev (Eds.), Micro-Mini Fuel Cells Fundamentals and

Applications, Springer Verlag, NATO Science Series - C (ISBN 978-1-4020-8294-8), 2008, pp. 13-26

- F. Barbir, Fuel Cell Stack and System Design Principles with Some Design Concepts of Micro-Mini Fuel Cells, in S. Kakac, A. Pramuanjaroenkij, L. Vasiliev (Eds.), Micro-Mini Fuel Cells – Fundamentals and Applications, Springer Verlag, NATO Science Series - C (ISBN 978-1-4020-8294-8), 2008, pp. 27-46
- F. Barbir, Fuel Cells for Clean Power Generation: Status and Perspectives, in J. Sheffield and C. Sheffield (eds.) Assessment of Hydrogen Energy for Sustainable Development, Springer Verlag, NATO Science for Peace Series C (ISBN 978-1-4020-6440-1), 2007, pp. 113-121
- 8. S.A. Sherif, F. Barbir, T.N. Veziroglu, M. Mahishi, and S.S. Srinivasan, Hydrogen Energy Technologies, in F. Kreith and D.Y. Goswami, (Eds.), *Handbook of Energy Efficiency and Renewable Energy*, CRC Press/Taylor & Francis Group, Boca Raton, Florida, (ISBN 0-8493-1730-4), 2007, pp. 27.1-27.16.
- 9. F. Barbir, PEM Fuel Cells Overview, in N.M. Sammes (ed.), *Fuel Cell Technology: Reaching Towards Commercialization*, Springer-Verlag, London, 2006, pp.27-52
- S.A. Sherif, F. Barbir and T.N. Veziroglu, Hydrogen Energy Solutions, in N.L. Nemerow and F.J. Agardy (Eds.) *Envronmental Solutions*, Elsevier/Academic Press, Burlington, MA, 2005, pp.143-180
- 11. F. Barbir, System Design for Stationary Power Generation, *Handbook of Fuel Cell Technology Fundamentals, Technology and Applications*, W. Vielstich, A.Lamm, and H. Gasteiger (eds.), Vol. 4, Part 3, J. Wiley, New York, 2003, pp. 683-692
- F. Barbir, Hydrogen Energy (in Croatian), a chapter in *Obnovljivi Izvori Energije (Renewable Energy Sources)*, B. Labudovic (ed.), EnergetikaMarketing, Zagreb, Croatia, 2002, pp. 407-409
- F. Barbir, S.A. Sherif and T.N. Veziroglu, Fundamentals of Hydrogen Energy Utilization, in *Advances in Solar Energy*, Y. Goswami and K. Boehr (eds.), Vol. 14, American Solar Energy Society, 2001, pp. 67-100
- 14. S.A. Sherif, F. Barbir, and T.N. Veziroglu, Hydrogen Energy System, in *Wiley Encyclopedia* of *Electrical and Electronic Engineering*, J.G. Webster (ed.), Vol. 9, pp.370-402, J. Wiley & Sons, New York, 1999
- 15. T.N. Veziroglu and F. Barbir, Transportation Fuel, Hydrogen, in *Encyclopedia on Energy Technology and the Environment*, A. Bisio and S.R. Boots (eds.), pp. 2712-2730, John Wiley & Sons, New York, 1995
- T.N. Veziroglu and F. Barbir, Hydrogen: The Ultimate Fuel and Comparison with Fossil Fuels, in *The Future of Energy Gases*, D. Howell, (ed.), U.S. Geological Survey Professional Paper 1570, pp. 715-724, 1993

### **Refereed Journal Articles:**

- 1. A.Z. Tomić, I. Pivac, F. Barbir, Impact of power profile in activation of proton exchange membrane electrolyzer cell, Journal of Power Sources 632, 236308 (2025)
- 2. N. Franić, I. Pivac, F. Barbir, A review of machine learning applications in electrochemical devices, Intl J Hydrogen Energy, 102 pp. 523-544 (2025)

- 3. M. Motaleb. I. Tolj, F. Barbir, Review of Proton Exchange Membrane Fuel Cells-Powered Systems for Stationary Applications Using Renewable Energy Sources, *Energies*, 17(15) 3814 (2024)
- 4. I. Pivac, J. Šimunović, F. Barbir, S. Nižetić, Reduction of greenhouse gases emissions by use of hydrogen produced in a refinery by water electrolysis, *Energy*, 296, 131157 (2024)
- 5. I. Pivac, A. Stoilova Pavasović, F. Barbir, Recent advances and perspectives in diagnostics and degradation of electrochemical hydrogen compressors, *Intl J. Hydrogen Energy*, in press (2023) IF 7.139
- 6. I. Pivac, Q. Meyer, Ch. Zhao, F. Barbir, Operando investigations of Proton Exchange Membrane Fuel Cells performance under air interruptions in dry and humidified condition, *Journal of Power Sources* 580 art.no. 233418 (2023)
- J. Šimunović, G. Radica, F. Barbir, The effect of components capacity loss on the performance of a hybrid PV/wind/battery/ hydrogen stand-alone energy system, accepted at *Energy Conversion & Management* 291 art. No. 117314 (2023) IF 11.533
- 8. A.Z. Tomić, I. Pivac, F. Barbir, A review of testing procedures for proton exchange membrane electrolyzer degradation, *Journal of Power Sources*, 557 art.no. 232569 (2023)
- 9. A.Z. Tomić, I. Marinić-Kragić, F. Barbir, One-parameter battery degradation model fpr optimization of islanded microgrid system, *Energy Sources, Part A: Recovery, Utilization and Environmental Effects*, 45 (1), pp. 1257-1273 (2023) IF 2.902
- D. Cikatić Šanić, F. Barbir, Stand-alone micro-trigeneration system coupling electrolyzer, fuel cell and heat pump with renewables, *International Journal of Hydrogen Energy*, 47, 35068-35080 (2022)
- 11. J. Šimunović, I. Pivac, F. Barbir, Techno-economic assessment of hydrogen refueling station: A case study in Croatia, *International Journal of Hydrogen Energy*, 47, 24155-24168 (2022)
- 12. A. Kravos, A. Kregar, Ž. Penga, F. Barbir, T. Katrašnik, Real-time capable transient model of liquid water dynamics in proton exchange membrane fuel cells, *Journal of Power Sources*, 541, 1-16 (2022)
- 13. I. Poljak, P. Županovic, F. Barbir, Ex-situ measurement of charge carrier concentration in PEM fuel cells by Hall effect, *Polymer Bulletin* Vol. 79, No. 3, pp. 1713-1727 (2022)
- 14. L. Xing, Y. Xu, Z. Penga, Q. Xu, H. Su, F. Barbir, W. Shi, J. Xuan, A segmented fuel cell unit with functionally graded distributions of platinum loading and operating temperature, *Chemical Engineering Journal*, Vol. 406, 126889 (2021)
- 15. L. Xing, Z. Xu, Ž. Penga, Q. Xu, H. Su, W. Shi, F. Barbir A novel flow field design with controllable pressure gradient across adjacent channels to enhance mass transport and water removal of PEM fuel cells, *AICHE Journal*, 66:e16957, (2020)
- Q. Meyer, I. Pivac, F. Barbir, C. Zhao, Detection of oxygen starvation during carbon corrosion in Proton Exchange Membrane Fuel Cells using Low-Frequency Electrochemical Impedance Spectroscopy, *Journal of Power Sources*, 470, 228285 (2020)
- I. Pivac and F. Barbir, Impact of Shutdown Procedures on Recovery Phenomenain Proton Exchange Membrane Fuel Cells, *Fuel Cells* Vol. 20, No.2, pp.185-195 (2020) DOI:10.1002/fuce.201900174

- 18. I. Tolj, Z. Penga, D. Vukicevic, F. Barbir, Thermal management of edge-cooled 1 kW portable proton exchange membrane fuel cell stack, *Applied Energy*, Vol. 257 Article 114038 (2020)
- 19. I. Halvorsen, I. Pivac, D. Bezmalinović, F. Barbir, F. Zenith, Electrochemical Low-Frequency Impedance Spectroscopy Algorithm for Diagnostics of PEM Fuel-Cell Degradation, *Intl. Journal of Hydrogen Energy* Vol. 45, pp. 1325-1334 (2019)
- Z. Penga, C. Bergbreiter, F. Barbir, J. Scholta, Numerical and experimental analysis of liquid water distribution in PEM fuel cells, *Energy Conversion and Management*, Vol. 189, pp. 167-173 (2019)
- 21. S. Nižetić, F. Barbir, N. Djilali, Role of Hydrogen in Energy Transition, Editoral in *Intl. J. Hydrogen Energy* Vol. 44, No. 20 (2019) pp. 9673-9674
- 22. N. Matulic, G. Radica, F. Barbir, Commercial vehicle auxiliary loads powered by PEM Fuel Cell, *Intl. J. Hydrogen Energy*, Vol. 44, No. 20 (2019) pp. 10082-10090
- Ž. Penga, G. Radica, F. Barbir, S. Nižetić, Coolant Induced Variable Temperature Flow Field for Improved Performance of Proton Exchange Membrane Fuel Cells, *Intl. J Hydrogen Energy*, Vol. 44, No. 20 (2019) pp. 10101-10119
- 24. F. Martinić, G. Radica, F. Barbir, Application Analysis of Solid Oxide Fuel Cells in Ship Energy Systems, *Brodogradnja/Shipbuilding*, Vol. 69, No. 4 (2018) pp 53-68
- I. Pivac, D. Bezmalinović, F. Barbir, Catalyst Degradation Diagnostics of Proton Exchange Membrane Fuel Cells Using Electrochemical Impedance Spectroscopy, *Intl. Journal of Hydrogen* Energy, Vol. 43, No. 29, (2018) pp. 13512-13520
- 26. I. Poljak, P. Županović, F. Barbir, Measurement of Proton Concentration in PEM by Hall Effect, *Fuel Cells*, Vol. 18, No. 4, (2018), pp. 408-412
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- I. Pivac, J. Šimunović, F. Barbir, N. Plavec, I. Andročec, Overview of hydrogen refueling stations and spatial occupancy assessment: preliminary results of the case study in Croatia, Proc. 6<sup>th</sup> International Conference on Smart and Sustainable Technologies, Splitech2021, Split and Bol, Croatia, 8-11 September 2021.
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### **Invited Keynote Lectures and Presentations:**

- 1. Hydrogen for Transportation, Invited leacture at CAETS2023 Annual Meeting and Technical Symposium, Zagreb, Croatia 9-11- October, 2023.
- 2. Why Hydrogen Critics Are Both Right and Wrong, Invited keynote lecture at Renewable Hydrogen Energy Convention, RHEC 2023, Zagreb, Croatia, 24. May 2023.
- 3. Sustainable Energy Supply for the Islands, Invited keynote lecture at MIC-Vis 2022, Mediterranean Islands Conference, Vis, Croatia 17-19. September 2022.

- 4. Common Misconceptions About Hydrogen and How to Debunk Them, Invited talk at the World Hydrogen Energy Conference, WHEC 2022, Istanbul, Turkiye, 26-30 June, 2022.
- 5. How Hydrogen Could Help Decarbonizing Energy Supply by 2050, International Conference on Emerging and Renewable Energy: Generation and Automation (ICEREGA2019), Istanbul, 30. October 1. November, 2019.
- 6. Role of Hydrogen Technologies in Decarbonization of Energy Supply, invited keynote lecture at 17th International Conference on Clean Energy, Shenyang, Kina, 9-12 August 2019.
- 7. Future of Hydrogen, Invited keynote lecture at 9th Intl. Conference on Hydrogen Production ICH2P 2018, Zagreb, Croatia, 14-16 July 2018
- 8. Applied Hydrogen Technologies, Invited lecture/workshop, Anadolu Energy Symposium AES2018, Edirne, Turkey, 18-20 April 2018.
- 9. F. Barbir, Status of hydrogen technologies and their role in energy future, plenary lecture at VI Symposium on Hydrogen Fuel Cells and Advanced Batteries, Hyceltec 2017, Porto, Portugal, 19-23 June 2017.
- F. Barbir, I. Pivac, D. Bezmalinovic, Diagnostics of PEM Fuel Cells Degradation, Keynote lecture at VI Symposium on Hydrogen Fuel Cells and Advanced Batteries, Hyceltec 2017, Porto, Portugal, 19-23 June 2017.
- 11. F. Barbir, Hydrogen and Fuel Cells Technologies: Status and Perspectives and Their Role in the Energy System of the Future, Keynote lecture at 9th International Exergy, Energy and Environment Symposium IEEES9, Split, Croatia, 14-17 May 2017
- 12. F. Barbir, Hydrogen and low-carbon energy strategy, Invited lecture at 32. International Scientific & Expert Meeting of Gas Professionals, Opatija, Croatia, 3-5 May 2017
- F. Barbir, Role of Hydrogen in Future Renewable Energy System, Invited Keynote Lecture at 4<sup>th</sup> International Conference on Renewable Energy: Generation and Applications, ICREGA 2016, Belfort, France, 8-10 February 2016.
- F. Barbir, Hydrogen Fuel for Transportation: Past, Present and Future, Invited Keynote Lecture at IDHEA International Discussion on Hydrogen Energy and Applications, Nantes, France,12-14 May 2014
- 15. F. Barbir, Water and Heat Management in PEM Fuel Cells, Invited Keynote Lecture at 5<sup>th</sup> International Conference on Fundamentals and Development of Fuel Cells, Karlsruhe, Germany, 16-18 April 2013
- F. Barbir, Heat and Mass Transfer in PEM Fuel Cells, Sofia Electrochemical Days, Sofia, Bulgaria, 10-13 December 2012
- 17. F. Barbir, PEM Fuel Cells Diagnostics as Design Tool, Invited presentation at Joined D-CODE & GENIUS annual workshop, Belfort, France, 13-14 June, 2012
- 18. F. Barbir, ICHET's Hydrogen Island Initiative: Projects Update, Invited presentation at STORIES Project Conference, Estoril, Portugal, 24-25. March 2010.
- F. Barbir, Hydrogen One of Energy Carriers for Future Energy Supply, Invited lecture at 10. Intl. Conference SLOBIOM 2009: Organic Agriculture and Healthy Food, Renewable Energy and Raw Materials for South-East Europe until 2030, Ljubljana 16. October 2009.
- 20. F. Barbir, The role of Hydrogen in Energy Supply in the Future, Invited presentation at Hrvatsko Energetsko Drustvo, Forum Dan energije, Zagreb, November 2008.

- 21. Fuel Cells: Engineering and Applications, Invited Keynote Lecture at First Regional Symposium on Electrochemistry for South-East Europe, Rovinj, Croatia, 4-8 May 2008.
- 22. Fuel Cells: Status of Development and Applications, Invited Keynote Lecture at International Hydrogen Energy Congress and Exhibition, Istanbul, Turkey, 13-15 July 2007
- 23. F. Barbir, Current Status and Challenges in PEMFC Stacks, Systems and Applications, Keynote Lecture, 16<sup>th</sup> World Hydrogen Energy Conference, Lyon, France, June 12-16, 2006
- 24. F. Barbir, Current Status and Challenges in Development of PEMFC Stacks and Systems Including Electrolyzers and Regenerative Fuel Cells, invited lecture at International Fuel Cell Symposium, Yuan Ze University, Chung-Li, Taiwan, September 2005
- 25. Fuel Cells and Hydrogen Economy, invited lecture at the International Hydrogen Energy Congress and Exhibition, Istanbul, Turkey, July 2005
- 26. F. Barbir, Hydrogen for Sustainable Development, invited lecture at the Dubrovnik Conference on Sustainable Development of Energy, Water and Environmental Systems, Dubrovnik, Croatia, June , 2005
- 27. F. Barbir and T.N. Veziroglu, Hydrogen Economy: Status and Outlook, invited lecture at 1<sup>st</sup> Intl. Conf. On Energy Efficiency and Conservation, Hong Kong, January 15-17, 2003
- 28. F. Barbir, PEM Fuel Cells Design, Engineering, Modeling and Diagnostic Issues, invited lecture at the NSF Workshop on Engineering Fundamentals of Low Temperature PEM Fuel Cells, Arlington, VA, November 2001

## SHORT COURSES/WORKSHOPS/SEMINAR LECTURES

- 1. Diagnostics of electrochemical hydrogen devices, Seminar lecture at Newcastle University, Newcastle upon Tyne, UK, 28 February 2025.
- 2. Fuel cell testing and diagnostics, Lecture at Training on Hydrogen and Fuel Cells, Dubrovnik, 02 October 2024.
- 3. Thermodynamics for Economists: Thermodynamic Unsustainability of Capitalism, Seminar lecture, Faculty of Economy, University of Osijek, Croatia, 26. February 2024.
- 4. Why Hydrogen Critics Are Both Right and Wrong, Seminar lecture at University of Edinburg, UK, 13 December 2023.
- 5. Mechanical Engineering Aspects of Research, Development and Applications of Electrochemical Energy Converters, Technical Faculty, University of Rijeka, Croatia, 16. November, 2022.
- 6. Electrochemical Impedance Spectroscopy in Diagnostics of Degradation in PEM Fuel Cells, Africa Centre of Excellence in Future Energies and Electrochemical Systems, Nigeria (ACE-FUELS) Webinar, 20. October, 2022.
- Heat and Water Management in PEM Fuel Cell without External Humidification of Reactant Gases, Seminar lecture at Newcastle University, Newcastle upon Tyne, UK, 12. December 2019
- 8. Diagnostics of PEM Fuel Cells, Seminar lecture at Beijing University of Technology, Beijing, China, 12. August 2019
- 9. Variable temperature flow field concept in PEM fuel cells: CFD modeling and experimental verification, Seminar lecture at Milan Polytechnic University, 24 May 2018

- 10. Applied Hydrogen Technologies, Workshop at 4<sup>th</sup> Anatolian Energy Symposium with International Participation, Trakya University, Edirne, Turkey, 18-20 April 2018
- 11. PEM Fuel Cells Degradation Diagnostics, Seminar Lecture at Argonne National Laboratory 21 February 2017.
- 12. Hydrogen and Low Carbon Energy Strategy, Seminar Lecture at Trieste University 04. May 2017.
- 13. Water and Heat Management in PEM Fuel Cells, Seminar Lecture at Indiana University Purdue University in Indianapolis (IUPUI), 11 February 2015.
- Degradation Mechanisms and Characterization of PEM Fuel Cells, lecture at Summer School Diagnostics and Prognostics of Fuel Cell Systems, FCLAB, Belfort, France, 01-04 July 2014.
- PEM Fuel Cells I and II and Outlook for PEM Fuel Cells, lectures 3<sup>rd</sup> Joint European Summer School for Fuel Cell and Hydrogen Technology, Iraklion, Greece, 23-27 September 2013.
- 16. Water and Heat Management in PEM Fuel Cells, Seminar Lecture at Aalborg University, Aalborg, Denmark, 21 May 2013.
- General Introduction to Fuel Cell Electrochemistry; Cell and Stack Design, lectures at 2nd Joint European Summer School for Fuel Cell and Hydrogen Technology, Iraklion, Greece, 24-28 September 2012,
- 18. Engineering Aspects of Fuel Cells, lecture at 6th European Summer School on Electrochemical Engineering, Zadar, Croatia, 16-21 September 2012
- 19. Fuel Cells: Past, Present Status and Applications, and Future Trends, Seminar Lecture at University of Wyoming, Laramie, WY, 10 April 2012
- 20. Thermodynamics and Electrochemistry of Low Temperature Fuel Cells; How to Progress on Low Temperature PEM Fuel Cells, lectures at First Joint European Summer School for Fuel Cell and Hydrogen Technology, Viterbo, Italy, 28 August – 02 September 2011
- 21. PEM Fuel Cells, Metal Hydrides, Reforming, Safety Aspects, Global Penetration of Hydrogen, Lectures at Seminar on Hydrogen and Fuel Cells, Zagreb, Croatia, 02 December 2010
- 22. Fuel Cell Stack Design; Design Principles of Fuel Cell Systems lectures at International Summer School on PEM Fuel Cells Applications and Integrations, Istanbul, Turkey, 19-23 July, 2010.
- 23. PEM Fuel cell Systems; Current State of PEM Fuel Cell Development; Toward World Hydrogen Economy, invited lectures at HySA Training Week, University of Western Cape, Bellville, South Africa, 12-16 April, 2010.
- Hydrogen and Fuel Cells, lecture at Seminar on Renewable Energy Sources, Center for Technology Transfer, Faculty of Mechanical Engineering and Naval Architecture, Zagreb, 19 February, 2010.
- 25. Engineering Aspects of PEM Fuel Cells Research and Development, lecture at Institute Rudjer Boskovic, Zagreb, Croatia, 13. July 2010.
- 26. Introduction to PEM Fuel Cells: Operating Principles, Stack and System Design and Applications, Two-day short course at UNIDO International Centre for Hydrogen Energy Technologies, Istanbul, Turkey, 16-17 September 2009.

- 27. Introduction to PEM Fuel Cells: Operating Principles, Stack and System Design and Applications, lectures at Seminar/Workshop Smart energy systems and fuel cells: on path to a sustainable future, Trieste University, Trieste, Italy 26. June, 2009.
- 28. Fuel Cell Basics Overview; Fuel Cell Heat Management, lectures at International Summer School on PEM Fuel Cell Fundamentals Istanbul, 14-18 July, 2008.
- 29. Fuel Cell Technology Status and Obstacles for Commercialization, lecture at Bocconi University, Milan, Italy, 23. May 2008.
- 30. How to make electricity from solar energy when the sun is not shining, lecture at Science Fest, Grahamstown, South Africa, 18 April, 2008.
- 31. Fuel Cells: Technology and Applications, seminar lecture at TOBB University of Economics and Technology, Ankara, Turkey, 15. February, 2008.
- 32. Fuel Cell Basic Chemistry, Electrochemistry and Thermodynamics; Fuel Cell Stack and System Design Principles with Some Design Concepts of Micro-Mini Fuel Cells, lectures at NATO Advanced Study Institute on Mini-Micro Fuel Cells as Electric Energy Generators, Çeşme-Izmir, Turkey, 22. July – 3. August, 2007.
- 33. PEM Fuel Cell Stacks and Systems: Design Principles, Challenges and Perspectives, 3 lectures (Stacks, Systems and Applications) at Workshop on Fuel Cells, International Centre for Condensed Matter Physics, University of Brasilia, Brasilia-DF, Brazil, 9-13 April, 2007.
- 34. Current status and challenges in PEM fuel cells deployment (and resulting R&D opportunities), lecture at Advanced Workshop Energies for the Future, Istanbul Technical University, Istanbul, Turkey, 7-9 December, 2006.
- 35. Electricity Generation with Fuel Cells, International Advanced Course on Renewable Energies, RERDEC, Istanbul, Turkey, June 2006.
- 36. Fuel Cell Fundamentals, Design, Operation and Applications; Mechanical Engineer's Adventures in PEM Fuel Cells R&D, two seminar lectures at Nigde University, Nigde, Turkey, June 2006.
- 37. Fuel Cell Systems and System Integration, Training Course at TUBITAK Marmara Research Center, Gebze, Turkey, 5-8 December, 2005
- 38. Hydrogen Energy System: Activities, Structure, Strategy and International Cooperation, lecture at Bulgarian Academy of Sciences and Arts, Sofia, Bulgaria, November 2005.
- 39. Fundamentals Workshop: How Fuel Cells Work..., Fuel Cell Summit 2005, Society of Manufacturing Engineers, Mohegan Sun, Connecticut, October 2005.
- 40. Mechanical Design and Analysis of Fuel Cell Stack; Fuel Cell System Design; Fuel Cell Performance Testing, Monitoring and Diagnostics; 3 lectures at Yuan Ze University, Taiwan, September 2005.

## PATENTS

- 1. U.S. Patent # US11,239,381B2 Control of an electrochemical device with integrated diagnostics, prognostics and lifetime management (2022)
- 2. European Patent EP 3,207,389B1 Control of an electrochemical device with integrated diagnostics, prognostics and lifetime management (2020)

- 3. U.S. Patent # US7,159,444 Combustible gas detection systems and method thereof (2007)
- 4. U.S. Patent # US7,153,409 Electrochemical cell system and method of operation (2006)
- 5. U.S. Patent # US7,006,898 Method and apparatus for operating and controlling a power system (2006)
- 6. U.S. Patent # US6,994,929 Electrochemical hydrogen compressor for electrochemical cell system and method for controlling (2006)
- 7. U.S. Patent # US6,617,065 Method and Apparatus for Maintaining Neutral Water Balance in a Fuel Cell System (2003)
- 8. U.S. Patent # US6,551,736 Fuel Cell Collector Plate with Improved Mass Transfer Channels, (2003)
- 9. U.S. Patent # US6,207,312 Self-Humidifying Fuel Cell, (2001)