

John H. Lienhard V
Abdul Latif Jameel Professor, Department of Mechanical Engineering
Massachusetts Institute of Technology
Room 3-166, 77 Massachusetts Avenue, Cambridge MA 02139-4307 USA
+1-617-253-3790 * lienhard@mit.edu * lienhard.mit.edu

Education

B.S. in Engineering with concentration in Thermal Engineering, *Summa cum laude*
Dept. Chemical, Nuclear, and Thermal Engineering, University of California at Los Angeles, 1982
M.S. in Heat and Mass Transfer
Dept. Chemical, Nuclear, and Thermal Engineering, University of California at Los Angeles, 1984
Ph.D. in Fluid Dynamics
Dept. Applied Mechanics and Engineering Sciences, University of California at San Diego, 1988

Academic Appointments (selected)

July 2014 – present	Abdul Latif Jameel Professor of Water and Mechanical Engineering
July 2014 – present	Founding Director, Abdul Latif Jameel Water and Food Systems Lab
July 2008 – April 2012	Associate Head, Mechanical Engineering Department
Feb 2009 – June 2014	Samuel C. Collins Professor of Mechanical Engineering
July 2008 – Nov. 2017	Founding Director, Center for Clean Water and Clean Energy
July 1997 – present	Director, Rohsenow Kendall Heat Transfer Laboratory
Jan 1988 – present	MIT faculty member

Most Recent Papers

Y.D. Ahdab, D. Rehman, G. Schücking, M. Barbosa, and J.H. Lienhard V, "Treating irrigation water using high-performance membranes for monovalent selective electrodialysis," *ACS ES&T-Water*, 2020. ([doi](#))

A.T. Bouma, J. Swaminathan, and J.H. Lienhard V, "Metrics matter: accurately defining energy efficiency in desalination," *J. Heat Transfer*, online 28 Aug. 2020, **142**(12):122101, Dec. 2020. ([doi](#))

Y. Roy and J.H. Lienhard V, "On the presence of solute-solvent coupling in reverse osmosis," *J. Membrane Sci.*, **611**:118272, 1 Oct 2020. ([doi](#))

Y.D. Ahdab, D. Rehman, and J.H. Lienhard V, "Brackish water desalination for greenhouses: improving groundwater quality using monovalent selective electrodialysis," *J. Membrane Sci.*, **610**:118072, 1 Sept. 2020. ([doi](#))

J.S. McNally, Z.H. Foo, A. Deshmukh, C.J. Orme, J.H. Lienhard V, A.D. Wilson, "Solute displacement in the aqueous phase of water-NaCl-organic ternary mixtures relevant to solvent-driven water treatment," *RSC Advances*, **49**(10):29516, 10 August 2020. ([doi](#))

J.H. Lienhard V, "Heat transfer in flat-plate boundary layers: a correlation for laminar, transitional, and turbulent flow," *J. Heat Transfer*, **142**(6):061805, June 2020. ([doi](#)) ([one-page summary](#))

Z. Xu, L. Zhang, L. Zhao, B. Li, B. Bhatia, K. Wilke, Y. Song, O. Labban, J.H. Lienhard V, R.Z. Wang, E.N. Wang, "Ultrahigh-efficiency desalination via a thermally-localized multistage solar still," *Energy & Environmental Sci.*, **13**(3):830-839, 2020. ([doi](#))

Q.J. Wei, C.I. Tucker, P.J. Wu, A. Trueworthy, E.W. Tow, and J.H. Lienhard V, "Impact of salt retention on true batch reverse osmosis energy consumption: experiments and model validation," *Desalination*, **479**:114177, 1 April 2020. ([doi](#))

H.W. Chung, J. Swaminathan, and J.H. Lienhard V, "Multistage pressure-retarded osmosis configurations: a unifying framework and thermodynamic analysis," *Desalination*, **476**:114230, 15 Feb. 2020. ([doi](#))

K.G. Nayar and J.H. Lienhard V, "Brackish water desalination for greenhouse agriculture: comparing the costs of RO, CCRO, EDR, and monovalent-selective EDR," *Desalination*, **475**:114188, 1 Feb. 2020. ([doi](#))

J. Swaminathan, E.W. Tow, R.L. Stover, and J.H. Lienhard V, "Practical aspects of design of batch reverse osmosis for energy efficient seawater desalination," *Desalination*, **470**:114097, 15 Nov. 2019. ([doi](#))

T. Altmann, J. Robert, A.T. Bouma, J. Swaminathan, and J.H. Lienhard V, "Primary Energy and Exergy of Desalination Technologies," *Applied Energy*, **252**:113319, 15 Oct. 2019. ([doi](#))

Eleven Other Significant Papers (from >275 peer-reviewed papers; N≈17000, H=60, GoogleScholar).

- G.P. Thiel, E.W. Tow, L.D. Banchik, H.W. Chung, J.H. Lienhard V, "Energy consumption in desalinating produced water from shale oil and gas extraction," *Desalination*, **366**:94-112, 15 June 2015. ([doi](#))
- D.M. Warsinger, J. Swaminathan, E. Guillen, H.A. Arafat, and J.H. Lienhard V, "Scaling and Fouling In Membrane Distillation for Desalination Applications," *Desalination*, **356**:294-313, 15 Jan. 2015. ([doi](#))
- R.K. McGovern and J.H. Lienhard V, "On the potential of forward osmosis to energetically outperform reverse osmosis desalination," *J. Membrane Sci.*, **469**:245-250, Nov. 2014. ([doi](#))
- A.K. Plappally and J.H. Lienhard V, "Energy Requirements for Water Production, Treatment, End Use, Reclamation, and Discharge," *Renewable & Sustain. Energy Rev.*, **16**(7):4818-4848, Sept. 2012. ([doi](#))
- K.H. Mistry, R.K. McGovern, G.P. Thiel, E.K. Summers, S.M. Zubair, and J.H. Lienhard V, "Entropy generation analysis of desalination technologies," *Entropy*, **13**(10):1829-1864, Sept. 2011 ([pdf](#)).
- G.P. Narayan, M.H. Sharqawy, E.K. Summers, J.H. Lienhard V, S.M. Zubair, and M.A. Antar, "The potential of solar-driven humidification-dehumidification desalination for small-scale decentralized water production," *Renewable & Sustainable Energy Reviews*, **14**(4):1187-1201, May 2010. ([doi](#))
- M.H. Sharqawy, J.H. Lienhard V, and S.M. Zubair, "The thermophysical properties of seawater: A review of existing correlations and data," *Desal. & Water Treatment*, **16**:354-380, April 2010. ([pdf](#)) ([codes](#))
- A.E. Bergles, J.H. Lienhard V, G.E. Kendall, and P. Griffith, "Boiling and Evaporation in Small Diameter Channels," *Heat Transfer Engineering*, **24**(1):18-40, 2003. ([pdf](#))
- X. Liu, J.H. Lienhard V, and J.S. Lombara, "Convective Heat Transfer by Impingement of Circular Liquid Jets," *J. Heat Transfer*, **113**(3):571-582, 1991. ([pdf](#))
- J.H. Lienhard V and C.W. Van Atta, "The decay of turbulence in thermally stratified flow," *J. Fluid Mechanics*, **210**:57-112, Jan. 1990. ([pdf](#))

Synergistic Activities

1. Industrial involvement: Co-founder, Gradient Corporation, desalination technology for treatment of industrial wastewaters. Scientific advisor, Sandymount Technologies. 36 issued US Patents and many more international patents, most licensed by the desalination and water treatment industry.
2. Research: Directed several large, multi-PI research programs in water, energy, and food, valued at more than \$100M. Direct supervisor of more than 90 graduate theses and postdoctoral associates. Author of more than 275 peer-reviewed research papers. Research group received 15 best paper/poster/presentation awards from journals and natl./intl. conferences during 2011-2019. More than 170 invited lectures. Has had funded international collaborations in Chile, China, India, Israel, Kuwait, Saudi Arabia, Singapore, Spain, United Arab Emirates, and elsewhere.
3. Editorial boards: *Experimental Heat Transfer* (1995-present); *Acta Mechanica* (2003-2011); *Journal of Heat Transfer* (2003-2006); *Desalination & Water Treatment* (2009-present); *Frontiers of Heat & Mass Transfer* (2010-present); *Intl. J. Thermal Sciences* (2010-present); *Desalination* (2011-present)
4. Textbooks/Teaching: Author of textbooks on [heat transfer](#), on [thermal modeling](#), and on [measurement & instrumentation](#). Heat transfer book has been online at no charge since 2002, and hundreds of thousands of copies have been downloaded worldwide. Measurements book has sold more than 130,000 copies. Created new courses on desalination, thermal modeling, and compressible flow. Managed ABET accreditation for MIT MechE department's 3 degrees (2007).
5. Professional Memberships. Board of Directors, International Desalination Association; American Society of Mechanical Engineers, Fellow; American Association for the Advancement of Science, Fellow; American Society of Thermal & Fluid Engineers; Scientific Council of the Intl. Centre for Heat & Mass Transfer; Tau Beta Pi; Sigma Xi; Registered Professional Engineer (Mechanical), MA.
6. Selected Honors & Awards. 1988, Presidential Young Investigator Award, NSF; 1991, Best Paper Award, 26th ASME/AIChE Heat Transfer Conf.; 1992, Ralph R. Teetor Award, SAE; 1993, Spira Teaching Award, MIT School of Engng; 1994, Graduate Student Council Teaching Award, MIT; 2003, Den Hartog Distinguished Educator, MIT; 2012, ASME Technical Communities Globalization Medal; 2015, ASME Heat Transfer Memorial Award; 2018, MIT Committed to Caring Award (grad. advising); 2018, Chief Guest, IIT Ropar Convocation; 2019, ASME E.F. Obert Award (best thermo paper).

Biographical sketch

John H. Lienhard V is the Abdul Latif Jameel Professor and the founding Director of the Abdul Latif Jameel Water and Food Systems Lab at MIT ([J-WAFS](#)). During more than three decades on the MIT faculty, Lienhard's research and educational efforts have focused on heat and mass transfer, water purification and desalination, and thermodynamics. He has also filled a number of administrative roles at MIT.

Lienhard received his bachelor's and master's degrees in thermal engineering at UCLA from the Chemical, Nuclear, and Thermal Engineering Department, where he worked on buoyant instabilities in solar collectors and evaporating meniscus measurements for MED desalination systems. He joined MIT immediately after completing his PhD in the Applied Mechanics and Engineering Science Department at UC San Diego, where he did wind-tunnel experiments on thermally stratified turbulent flows. Lienhard's research on water purification includes humidification-dehumidification desalination, membrane distillation desalination, forward and reverse osmosis, nanofiltration, electrodialysis, solar-driven desalination, solvent extraction, bubble columns, scale formation and membrane fouling, salinity gradient power, management of high salinity brines, thermodynamic and energy efficiency analysis of desalination cycles, treatment of wastewater from oil/gas operations, and energy-water nexus issues. Lienhard has also done research on high heat flux engineering, liquid jet impingement cooling, and electronics thermal management. Lienhard has directly supervised more than 90 graduate theses and postdoctoral associates, and is author of more than 275 peer-reviewed publications. He has been issued 36 US patents, most of which have been commercialized through start-up companies.

Lienhard is a Fellow of the American Society of Mechanical Engineers (ASME) and a Fellow of the American Association for the Advancement of Science (AAAS). He is a recipient of the 1988 National Science Foundation Presidential Young Investigator Award, the 1992 SAE Teetor Award, a 1997 R&D 100 Award, the 2012 ASME Technical Communities Globalization Medal, and the 2015 ASME Heat Transfer Memorial Award, and the 2019 ASME Edward F. Obert Award. Lienhard and his students received fifteen best paper, poster, or presentation awards at national and international conferences and from journals for their desalination research during 2011-2019. Lienhard is a registered professional engineer in the Commonwealth of Massachusetts.

Lienhard is the co-author of textbooks on heat transfer, on measurement and instrumentation, and on thermal modeling. His heat transfer book has been available online at no charge since 2002, and hundreds of thousand copies have been downloaded worldwide (ahtt.mit.edu). His measurements book has sold more than 130,000 copies. He has created new courses on desalination, on thermal modeling, and on compressible fluid mechanics. He has received several teaching awards at MIT, including the Ruth and Joel Spira Award, the Den Hartog Distinguished Educator Award, and the Graduate Student Council Teaching Award. He has also been recognized by MIT for outstanding graduate student mentorship.

Lienhard has served as Associate Head and Undergraduate Officer of the MIT Department of Mechanical Engineering, and was responsible for ABET accreditation of the department's three SB degrees. He has filled 100 varied service roles at MIT.

Professor Lienhard has been the Director of the Rohsenow Kendall Heat Transfer Laboratory since 1997 ([RKLab](#)), and he was the founding Director of the Center for Clean Water and Clean Energy and of the Ibn Khaldun Fellowship program for Saudi Arabian Women ([IBK](#)). His research collaborations have extended to Chile, China, India, Israel, Kuwait, Saudi Arabia, Singapore, Spain, United Arab Emirates, and elsewhere. As Director of J-WAFS, he coordinates MIT's research in food security and water supply for a growing population on a changing planet.

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