

Ing. Jan Špale, Ph.D.

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Date and place of birth: 20.7.1996, Kladno

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Publication track record: h-index 10, 421 citations (Google Scholar, 01/10/2025)

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Professional experience

- **04/2025 – now – Assistant Professor – Department of Energy Engineering, FME CTU in Prague**, delivering exercises and classes to Master students of Energy Engineering study track; responsible for two experimental laboratory units – reversible heat pump with climate chambers and demonstrational unit of a small scale steam power plant
- **05/2017 – now – Energy Engineer in R&D – Energy Systems in buildings**, laboratory of Organic Rankine Cycles at University Centre for Energy Efficient Buildings (UCEEB), CTU in Prague. Development of a biomass fired micro-CHP ORC plant. Thermal cycles modelling. Research project management. Experimental investigation of energy systems in buildings. Energy consultancy for industries. Industrial thermal energy systems.

Education

- **02/2021 – 04/2025 Faculty of Mechanical Engineering, CTU in Prague** – Doctoral studies in Energy & Process Engineering, graduated with honours, dissertation topic: Small-scale Vapor Expansion Machines for Distributed Energy Systems
- **09/2018 – 01/2021 Faculty of Mechanical Engineering, CTU in Prague** – Master studies in Energy engineering, graduated with honours

International experiences

- **08/2023 – 05/2024 – Fulbright Visiting Scholar – Ray W. Herrick Laboratories, Purdue University** – Fulbright researcher in the field of high temperature heat pumps for industrial decarbonization
- **09/2018 - 02/2019 – Renewable energy sources**, focus on turbomachinery, renewable energy and computational fluid dynamics; Erasmus+ Master study exchange programme at **Politécnico di Milano**
- **07/2016 – Sustainable engineering** summer school at **KU Leuven**

Professional honors, awards and fellowships

- **Fulbright-Masaryk Visiting Scholar @ Purdue University**, 2023-2024
- Conference Best Paper Award – ASHRAE Annual Conference 2025 Phoenix – Navigating Long-Term Use of Refrigerant Blends in Unitary Air-Source Heat Pumps for Colder Climates (PX-25-C037)
- Conference Student Paper Award – Purdue Herrick Conferences 2024 - 20th International Refrigeration and Air Conditioning Conference – 2nd place for “Low-GWP Working Fluid Mixtures Screening for Industrial High Temperature Heat Pumps with Supply Temperature >200 °C”
- Awardee of “*Scholarship for gifted students 2021*” by CTU in Prague
- Conference Best Paper Award – TMREES2019 “Intermediate Pressure Reboiling in Geothermal Flash Plant for Increased Power Production and More Effective Non-condensable Gas Abatement”
- Award for long-term extraordinary study results at Grammar school Kladno (*summa cum laude*)

Knowledge and skills

- Language: Czech (native language), English (fluent, technical and academic writing and presenting), Russian (B1)
 - Driver's licence B (personal car)
 - Computational and computer skills – 3D CAD, ANSYS Fluent, LaTeX, Python, advanced MS Office, GitHub, basic web design
 - Research project management
 - Presentation skills, meeting facilitation and negotiations
 - Team leading experience (team leader of 40 students at CTU)
 - Enthusiastic for research in industrial thermal energy systems
 - Solid background in thermodynamics, fluid mechanics, turbomachinery, mechanical design and experimental research
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Research focus

- Novel distributed energy systems in buildings
- Organic Rankine cycle power systems
- Microcogeneration systems for industrial plants
- Advanced heat pumps and refrigeration technology
- Working fluid selection and mixtures for high temperature heat pumps
- Small scale turbomachinery for distributed energy systems
- Pumped thermal energy storage (PTES) – Carnot Batteries

Participation in research projects

1. TJ01000090 - Research of additive manufacturing (3D print) possibilities for manufacturing of expanders for low temperature decentralized energy applications – 2017-2019, Provider: Technology Agency of Czech Republic, partners: Metal 3D, s.r.o.
2. TK02020123 - Direct waste heat recovery from internal combustion engine by Organic Rankine Cycle, 2019-2020, Provider: Technology Agency of Czech Republic, partners: MSFA, s.r.o.
3. TO01000160 - Optimised expanders for small-scale distributed energy systems, 2020-2024, Provider: Technology Agency of Czech Republic, NTNU Trondheim, SINTEF, GT-Progres, s.r.o.
4. TJ04000326 - Waste heat recovery for pumped thermal electricity storage - Carnot batteries, 2020-2022, Provider: Technology Agency of Czech Republic, partners: TČ MACH, s.r.o.
5. 8E18B012 - Low cost turboexpanders for decentralized energy applications – possibilities of 3D print manufacturing from modern plastic materials, 2018-2020, Provider: The Bavarian-Czech Academic Agency, partners: OTH Amberg-Weiden

6. Energy Efficiency Network – a cross-border energy consultant training, 2020-2022, **principal investigator**, Provider: The European Climate Initiative (EUKI), partners: OTH Amberg-Weiden, Association of Energy Services Providers
7. SGS21/111/OHK2/2T/12 - Micro-scale turbines for distributed energy systems, 2020-2022, **principal investigator**, provider: CTU in Prague
8. BTHA-MOB-2020-1 - Research mobility focused on micro turboexpander design for Organic Rankine cycles and experimental work at Drucklufttechnik laboratory at OTH, 13.1.-7.2.2020, **principal investigator**, provider: The Bavarian-Czech Academic Agency (BTHA)
9. TK04010286 - Analysis of the potential for development of micro-cogeneration in the Czech Republic and a proposal for a suitable incentive system, 2022-2023, provider: Technology Agency of Czech Republic, partners: SEVEN, The Energy Efficiency Center
10. TK04020283 - Tribotechnics of volumetric expanders for distributed energy systems, 2022-2023, provider: Technology Agency of Czech Republic, partners: Šlechta, a.s.
11. TS01030218 – Rock Accumulation of Seasonal Heat, 2024-2028, provider: Technology Agency of Czech Republic, partners: WATRAD, s.r.o., SG Geotechnika a.s., PROGEO, s.r.o.

Membership and activities in professional associations

- **Knowledge Center on Organic Rankine Cycle technology (KCORC)** – Editorial Committee member, social media content and web content
- **American Society of Mechanical Engineers (ASME)** – student member, Gas Turbine Institute and ASME TurboExpo conferences
- **American Society for Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)** – student member of Central Indiana Chapter, student committee
- **International Energy Agency (IEA)** – Energy Storage Technology Collaboration Program (ES-TCP) – Alternate delegate of the Czech Republic in the executive committee

Extracurricular activities and community service

- **Board of European Students of Technology (BEST) CTU Prague** – member since 07/2016, an international non-profit and non-political organisation providing communication, co-operation and exchange possibilities for students of technical universities in Europe since 1989;
 - **President of the IXth local board** (07/2017 – 07/2018) at CTU in Prague – leading a local branch consisting of over 40 students;
 - Main organizer of Summer course 2017 focused on Engineering psychology;
 - Long-term member of Public relations working group focusing on social media and promotion of possibilities to study abroad for CTU students
- opponent of project proposals aimed at transformation of energy sector and energy transition (Theta programme) under **Technology Agency of Czech Republic**
- Member of the **Parliament of the Student Union CTU** 07/2017-07/2018
- Lecturer of young pupils (11-13 years old) in natural sciences at **Kladno Grammar school** – Biology and Physics, 2013-2015, organizing field trips and laboratory experiments

Research publication bibliometric records

- [1] V. Novotny, J. Spale, B. B. Stunova, M. Kolovratnik, M. Vitvarova, and P. Zikmund, "3D Printing in Turbomachinery: Overview of Technologies, Applications and Possibilities for Industry 4.0," in *ASME Turboexpo 2019*, Phoenix: ASME International, 2019. doi: 10.1115/gt2019-91849.
- [2] V. Novotny *et al.*, "Design and manufacturing of a metal 3D printed KW scale axial turboexpander," in *Proceedings of the ASME Turbo Expo*, 2019. doi: 10.1115/GT2019-91822.

- [3] V. Novotný, D. J. Szucs, J. Spale, V. Vodicka, J. Mascuch, and M. Kolovratník, "ABSORPTION POWER CYCLE WITH LiBr SOLUTION WORKING FLUID-DESIGN OF THE PROOF-OF-CONCEPT UNIT," in *5 th International Seminar on ORC Power Systems*, Athens, 2019.
- [4] J. Mascuch, V. Novotny, V. Vodicka, Z. Zeleny, and J. Spale, "Set-up and Pilot Operation of an In-house Developed Biomass ORC μ CHP in the Czech Republic," pp. 1–9, 2019.
- [5] A. P. Weiss *et al.*, "Uncommon turbine architectures for distributed power generation – development of a small velocity compounded radial re-entry turbine," *Arch. Thermodyn.*, vol. 41, no. No 4, pp. 235–253, 2020, doi: 10.24425/ather.2020.135862.
- [6] V. Novotny, D. J. Szucs, J. Spale, V. Vodicka, J. Mascuch, and M. Kolovratnik, "Investigation of novel configuration for dual organic rankine cycle configurations for maximization of waste heat utilization," in *Refrigeration Science and Technology*, International Institute of Refrigeration, 2020, pp. 36–43. doi: 10.18462/iir.rankine.2020.1108.
- [7] V. Novotny, M. Vitvarova, J. Spale, and J. P. Jakobsen, "Intermediate pressure reboiling in geothermal flash plant for increased power production and more effective non-condensable gas abatement," *Energy Rep.*, vol. 6, pp. 20–27, 2020, doi: 10.1016/j.egyr.2019.10.014.
- [8] J. Mascuch, V. Novotny, V. Vodicka, J. Spale, and Z. Zeleny, "Experimental development of a kilowatt-scale biomass fired micro – CHP unit based on ORC with rotary vane expander," *Renew. Energy*, vol. 147, pp. 2882–2895, 2020, doi: 10.1016/j.renene.2018.08.113.
- [9] A. P. Weiß *et al.*, "Customized ORC micro turbo-expanders - From 1D design to modular construction kit and prospects of additive manufacturing," *Energy*, p. 118407, Jul. 2020, doi: 10.1016/j.energy.2020.118407.
- [10] J. Mascuch, J. Spale, V. Vodicka, Z. Zeleny, and V. Novotny, "Paper ID : 19 , Page 1 SCALING-UP A BIOMASS FIRED MICRO-CHP ORC FOR BETTER PERFORMANCE TOWARDS COMMERCIALIZATION Paper ID : 19 , Page 2," pp. 1–10, 2021.
- [11] V. Novotny, J. Spale, J. Pavlicko, D. J. Szucs, and M. Kolovratnik, "Experimental investigation of a kW scale absorption power cycle with LiBr solution," in *6th International Seminar on ORC power systems*, Munich, Germany, 2021, p. (accepted manuscript).
- [12] J. Mascuch, V. Novotny, J. Spale, V. Vodicka, and Z. Zeleny, "Experience from set-up and pilot operation of an in-house developed biomass-fired ORC microcogeneration unit," *Renew. Energy*, vol. 165, pp. 251–260, Mar. 2021, doi: 10.1016/j.renene.2020.11.021.
- [13] V. Novotny, J. Spale, D. Suchna, J. Pavlicko, M. Kolovratnik, and A. P. Weiß, "Absorption power cycle with a 3D-printed plastic micro turboexpander - Considerations, design and first experimental results," *AIP Conf. Proc.*, vol. 2323, no. 1, p. 070003, Mar. 2021, doi: 10.1063/5.0041429.
- [14] J. Spale, V. Novotny, V. Mares, and A. P. Weiß, "3D printed radial impulse cantilever micro-turboexpander for preliminary air testing," *AIP Conf. Proc.*, vol. 2323, no. 1, p. 070002, Mar. 2021, doi: 10.1063/5.0041433.
- [15] V. Novotny, D. J. Szucs, J. Špale, H.-Y. Tsai, and M. Kolovratnik, "Absorption Power and Cooling Combined Cycle with an Aqueous Salt Solution as a Working Fluid and a Technically Feasible Configuration," *Energies*, vol. 14, no. 12, Art. no. 12, Jan. 2021, doi: 10.3390/en14123715.

- [16] V. Novotny, S. Mach, M. Rathan, V. Basta, and J. Spale, "Modelling and experimental development of a waste heat upgrade integrated ORC Carnot battery with stone dust thermal storage," in *6th International Seminar on ORC power systems*, Munich, Germany, 2021.
- [17] V. Novotny, J. Spale, D. J. Szucs, H. Tsai, and M. Kolovratnik, "ScienceDirect Direct integration of an organic Rankine cycle into an internal combustion engine cooling system for comprehensive and simplified waste heat recovery," *Energy Rep.*, vol. 7, no. May, pp. 644–656, 2021, doi: 10.1016/j.egy.2021.07.088.
- [18] J. Spale, G. C. Jun, V. Novotny, P. Streit, A. P. Weiß, and M. Kolovratnik, "Development of a 10 kW class axial impulse single stage turboexpander for a micro-CHP ORC unit," *EPJ Web Conf.*, vol. 264, p. 01044, Jul. 2022, doi: 10.1051/epjconf/202226401044.
- [19] J. Spale, V. Novotny, J. Novotny, A. P. Weiß, and M. Kolovratnik, "Experimental Development of Additively Manufactured Turboexpanders towards an Application in the ORC," in *Heat Powered Cycles 2021*, Bilbao, Spain, 2021.
- [20] D. Kim, R. Mocholí Montañés, L. Riboldi, L. O. Nord, J. Spale, and V. Novotny, "Design optimization of small-scale ORC cycles for fluctuating heat source," in *Proceedings of the 63rd International Conference of Scandinavian Simulation Society, SIMS 2022, Trondheim, Norway, September 20-21, 2022*, Linköping University Electronic Press, 2022. Accessed: Nov. 26, 2024. [Online]. Available: <https://ntnuopen.ntnu.no/ntnu-xmlui/handle/11250/3047238>
- [21] V. Novotny, V. Basta, P. Smola, and J. Spale, "Review of Carnot Battery Technology Commercial Development," *Energ. 2022 Vol 15 Page 647*, vol. 15, no. 2, p. 647, Jan. 2022, doi: 10.3390/EN15020647.
- [22] J. Spale, J. Pavlicko, V. Vodicka, J. Mascuch, and V. Novotny, "Experimental investigation of combustion engine with novel jacket and flue gas heat recovery," *Energy Rep.*, vol. 8, no. May, pp. 593–604, 2022, doi: 10.1016/j.egy.2022.07.073.
- [23] J. Spale, V. Vodicka, Z. Zeleny, J. Pavlicko, J. Mascuch, and V. Novotny, "Scaling up a woodchip-fired containerized CHP ORC unit toward commercialization," *Renew. Energy*, vol. 199, pp. 1226–1236, Nov. 2022, doi: 10.1016/j.renene.2022.08.144.
- [24] A. Basta, V. Basta, J. Spale, T. Dlouhy, and V. Novotny, "Conversion of combined heat and power coal-fired plants to Carnot batteries - Prospective sites for early grid-scale applications," *J. Energy Storage*, vol. 55, no. PB, p. 105548, 2022, doi: 10.1016/j.est.2022.105548.
- [25] V. Novotny, J. Spale, J. Pavlicko, D. J. Szucs, and M. Kolovratnik, "Experimental development of a lithium bromide absorption power cycle," *Renew. Energy*, vol. 207, pp. 321–347, May 2023, doi: 10.1016/j.renene.2023.02.123.
- [26] J. Špale, A. Hoess, I. Bell, and D. Ziviani, *Low-GWP Working Fluid Mixtures Screening for Industrial High Temperature Heat Pumps with Supply Temperature >200 °C*. 2024.
- [27] P. Streit *et al.*, "Concept and Design of a Velocity Compounded Radial Four-Fold Re-Entry Turbine for Organic Rankine Cycle (ORC) Applications," *Energies*, vol. 17, no. 5, Art. no. 5, Jan. 2024, doi: 10.3390/en17051185.
- [28] J. Spale, A. J. Hoess, I. H. Bell, and D. Ziviani, "Exploratory study on low-GWP working fluid mixtures for industrial high temperature heat pump with 200 °C supply temperature," *Energy*, vol. 308, p. 132677, Nov. 2024, doi: 10.1016/j.energy.2024.132677.

[29] J. Spale, V. Vodicka, P. Streit, V. Novotny, L. Volfl, and M. Kolovratnik, "Experimental Investigation of a Supersonic Axial Impulse Turbine for a Biomass-fired ORC CHP System," in *1st Belgian Symposium of Thermodynamics Proceedings*, Liege, Belgium: accepted for publication, Dec. 2024.

WoS: [1,2,5,7,8,9,12,13,14,15,17,21,22,23,24,25,27]

Scopus: [1,2,5,6,7,8,9,10,11,12,13,14,15,17,18,21,22,23,24,25,27,28]

Q1: [8,12,23,25]

D1: [9,24,28]