MOSTAFA BABAEI

PhD Candidate

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Professional Summary

Dynamic PhD researcher specializing in industrial decarbonization, thermodynamic modeling, and advanced high temperature heat pump integration. I develop physics based and data driven methods for optimal heat pump configuration, placement, and techno economic assessment, with applications across Swiss industrial sectors. As the developer of the ASTRA framework, my work combines thermodynamics, superstructure modeling, and machine learning to accelerate electrification and support strategic decision making for industrial energy systems.

Skills

Technical Skills

- Energy systems modeling & optimization
- Programming (Python, MATLAB)
- Machine Learning (ML) methods in Energy
- Thermodynamic and heat pump simulation
- Techno economic assessments
- Data analytics and scientific visualization

Soft Skills

- Teamwork and collaboration
- Project management
- Scientific communication
- Teaching and mentoring
- Critical thinking & Problem solving
- Interdisciplinary cooperation

Work History

Research/Teaching Assistant   08/2022 to Current

University Of Geneva *– Geneva, Switzerland*

- Developing the ASTRA superstructure to identify optimal high temperature heat pump configurations for industrial electrification.
- Implementing Carnot based screening, evolutionary optimization, and data driven compressor behavior.
- Applying heat pump electrification strategies across Swiss industrial sectors including paper, dairy, chocolate, and meat processing.
- Conducting techno economic evaluation of electrification scenarios and boiler interactions.
- Teaching the *Pinch Analysis* course, designing materials and assignments while providing constructive feedback.
- Guiding students in field-based courses like *Environnement Alpin et Sociétés,* focusing on practical applications.
- Supporting student learning by clarifying complex concepts and offering tailored explanations.

Research Assistant   02/2019 to 05/2022

K.N. Toosi University of Technology *– Tehran, Iran*

- Led projects on multi-generating plants with renewable energy and storage systems.
- Supervised research on energy optimization and system integration.
- Conducted feasibility studies for CCHP plants with renewable and storage technologies.
- Developed sustainable energy configurations and applied machine learning for optimization.
- Research outcomes resulted in multiple peer reviewed publications in international energy journals.

Intern   06/2018 to 03/2020

Niroo Research Institute (NRI) *– Tehran, Iran*

- Researched hybrid energy systems and thermal energy storage for hydrogen applications.

- Improved refrigeration efficiency using hybrid cycles and nanoparticle enhancements.
- Supported staff, analyzed problems, and contributed to innovative solutions.

Education

Ph.D.: Environmental Science (With focus on Industrial energy efficiency)   08/2022 to Current

University of Geneva - Geneva, Switzerland

- Conducting research under SWEET DeCarbCH project, funded by the Swiss Federal Office of Energy (SFOE).
- Focusing on decarbonizing the Swiss industry through process integration methods and novel, energy-efficient heating/cooling technologies.
- Developer of ASTRA (AI based superstructure for thermal system automated design).
- Research interests include machine learning for compressor performance, real cycle modeling, and industrial electrification strategies.

M.Sc.: Mechanical Engineering (Energy Systems)   09/2019 to 05/2022

K.N. Toosi University of Technology - Tehran, Iran

- **Thesis:** Thermodynamic analysis of an innovative hybrid multi-generating liquid air energy storage system. Awarded a perfect thesis mark:

  20.00/20.00 .

  Overall GPA: **18.73/20** (4.0/4.0).
- **Key Achievements:**

  Ranked **1st** among students in the Energy Systems Faculty, Department of Mechanical Engineering (Summer 2021).

B.Sc.: Mechanical Engineering   09/2014 to 02/2019

K.N. Toosi University of Technology - Tehran, Iran

- **Thesis:** Scrutinizing the effect of nanoparticle addition to a novel absorption-recompression refrigeration system. Awarded a thesis mark of

  19.00/20.00 (4.0/4.0).
- **Key Achievements:** Ranked in the **top 2%** among ~300,000 applicants in the Nationwide Universities Entrance Exam for Undergraduate Studies.

Publications

Peer-reviewed journal articles

1. Quantifying the effect of nanoparticle addition to a hybrid absorption–recompression refrigeration cycle. **Journal of Cleaner Production, 2020**.
2. Thermodynamic analysis and optimization of a hybrid multi-generating liquid air energy storage system. **Journal of Energy Storage, 2021**.
3. Comprehensive analysis of a biomass-driven CHP plant with compressed air energy storage. **Energy Conversion and Management, 2022**.
4. Optimizing energy use in the pulp and paper industry: Pinch, techno-economic, and sensitivity analyses on an innovative heat recovery system. **Journal of Cleaner Production, 2025**.
5. Deep decarbonization of the pulp and paper industry: Heat integration and techno-economic analysis with tailored heat pumps. **Energy, 2025**.

Submitted / in preparation

6. Carnot-based prefiltering and data-informed optimization framework for industrial high temperature heat pump integration. **Submitted**.
7. Data-driven prediction and selection of commercial compressors using limited thermodynamic inputs: Hybrid neural network and k-nearest-neighbors framework. **In preparation**.

Languages

English

Bilingual or Proficient (C2)

Persian

Bilingual or Proficient (C2)

French

Elementary (A2)

German

Beginner (A1)