



**Gheorghe Asachi Technical University of Iași**  
**Faculty of Electrical Engineering, Energetics and**  
**Applied Informatics**



**HABILITATION THESIS**  
*(abstract)*

**CONTRIBUTIONS TO INCREASING THE ENERGY  
AND ECONOMIC EFFICIENCY OF COGENERATION  
SYSTEMS**

**Domain: POWER ENGINEERING**

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## ABSTRACT

of the habilitation thesis entitled

**„Contributions to increasing the energy and economic efficiency of cogeneration systems”**

The main objective of the habilitation thesis is to present the author's most important achievements after obtaining the PhD title at the Gheorghe Asachi Technical University of Iași, in 2001, in the field of *Power Engineering*, with the thesis "*Contributions to the optimization of technological proper and specific consumptions in the thermal power plants on coal*", completed under the guidance of Professor Laurian PREDA.

The motivation for choosing the topic is closely related to the concerns and professional experience accumulated by the author in the field of electricity and heat production in cogeneration.

The habilitation thesis was structured in three parts (Part I - research directions addressed after the award of the PhD title; Part II - the evolution and prospects of the teaching and research career; Part III - the own and general bibliographical references used in writing the thesis) and six chapters that will be presented synthetically below.

**Chapter 1** of the thesis presents technical and economic aspects regarding cogeneration electricity and heat production technologies. Contributions in this direction are represented by the publication of a specialized book by Matrix Rom Publishing House and 7 articles published in specialized conference proceedings as first author:

- **Atănăsoae P.** (2020), *Cogeneration and trigeneration (Cogenerare și trigenerare)*. Editura Matrix Rom, București, ISBN 978-606-25-0556-1.
- **Atănăsoae P.**, Pentiuc R.D., Ungureanu C., Hopulele E., Ungureanu L.G. (2025), *Biogas as a Circular Energy Vector: Integrating Cogeneration into the Organic Waste Recovery Chain*. 2025 International Conference on Electromechanical and Energy Systems (SIELMEN), 16 – 18 October 2025, Chișinău, Republica Moldova.
- **Atănăsoae P.**, Pentiuc R.D., Milici R.M., Hopulele E., Mihai I. (2018), *Promoting the Electricity Generation from Biomass in Romania*. 10th International Conference and Exposition on Electrical and Power Engineering (EPE 2018), 18-19 October 2018, Iasi, Romania, pg.373-376.
- **Atănăsoae P.**, Pentiuc R., Bobric C., Olariu E., Martin V. (2017), *Technical and Economic Analysis of Thermal Energy Storage in the Biomass CHP Plants with ORC Technology*. Annals of the University of Craiova, No. 41, Vol. 41, Issue 1, 2017, ISSN 1842 – 4805, pg.162-167.
- **Atănăsoae P.**, Pentiuc R., Hopulele E. (2016), *Energy Recovery of Municipal Solid Waste for Combined Heat and Power Production*. 2016 International Conference and Exposition on Electrical and Power Engineering (EPE 2016), 20-22 October 2016, Iasi, Romania, pg.842-845.
- **Atănăsoae P.** (2012), *The Technical and Economic Analysis of the Trigeneration Plants*, 2012 International Conference and Exposition on Electrical and Power Engineering (EPE 2012), 25-27 October 2012, Iasi, Romania, pg.968-971.
- **Atănăsoae P.** (2009), *Using the fuel cells for cogeneration applications*. 7th International Conference on Electromechanical and Power Systems (SIELMEN), 6-10 October 2009, vol.1, pg.333-336, ISBN 978-606-520-617-5.
- **Atănăsoae P.** (2008), *Trigeneration, an efficient solution for the combined heat and power plants of Romania*. In the Bulletin of the Polytechnic Institute of Iasi, tomul LIV (LVIII), fasc. 3, 2008, pg.499-502, ISSN 1223-8139.

**Chapter 2** presents applications of cogeneration and trigeneration in buildings. In most cases, the energy supply sources of a building are considered and analysed individually. Treating them together rather than individually can lead to several benefits. These benefits can be summarized as: continuity of energy supply, flexibility of supply and optimization potential. The interaction between these energy systems was considered using the energy hub concept. This approach can substitute or even eliminate an unattractive energy carrier, for example one with high cost or high

carbon dioxide emissions. The most important contributions in this direction are represented by the publication of an article in a WoS indexed journal and 3 articles published in specialized conference proceedings as first author:

- **Atănăsoae P.**, Pentiu R. (2018), *Choosing the Energy Sources Needed for Utilities in the Design and Refurbishment of Buildings*. Buildings 2018, 8(4), 54.
- **Atănăsoae P.** (2015), *Applications of the Organic Rankine Cycle using renewable energy sources*, The 7th “Romanian International Conference on Energy Performance of Buildings” (RCEPB 2015), 28 – 29 May, 2015, București, Romania, ISSN 2286-2196.
- **Atănăsoae P.** (2014), *Modelling of systems with multiple energy carriers in buildings*, The 6th “Romanian International Conference on Energy Performance of Buildings” (RCEPB-VI), 5 – 6 June, 2014, Bucharest, Romania, ISSN 2286-2196.
- **Atănăsoae P.** (2010), *Cogeneration installations for buildings*. National Conference "Energy Performance of Buildings and Related Installations", Romanian Association of Installation Engineers – Technical University of Civil Engineering Bucharest, 27 May 2010, ISSN 2066-4583.

**Chapter 3** addresses the specific features of high-efficiency cogeneration. The promotion of high-efficiency cogeneration, based on useful heat demand, is a priority for governments in many countries, given the potential benefits of cogeneration in terms of saving primary energy, avoiding network losses and reducing greenhouse gas emissions. In this regard, there are numerous support schemes consisting of either investment support (capital subsidies, exemptions or reductions on the purchase of goods) or operating support (price subsidies, green certificates, tax exemptions or reductions). The main contributions in this direction are represented by the publication of a book chapter abroad, the publication of an article in a WoS indexed journal, 2 articles published in specialized conference proceedings as first author and 5 research and development contracts with the economic environment as project manager:

- **Atănăsoae P.** (2020), *Techno-Economic Assessment of High Efficiency Cogeneration* (Chapter 5, 30 pg.). Advances in Energy Research book, Editor Morena J. Acosta, Nova Science Publishers, USA, ISBN: 978-1-53618-136-4, pg.123-152.
- **Atănăsoae P.**, Pentiu R., Popescu P., Martin V. (2018), *Factors which Influence the Qualification of the Electricity Production in High Efficiency Cogeneration for Biomass Combined Heat and Power Plants*. Procedia Manufacturing 2018, 22, 651–658.
- **Atănăsoae P.**, Pentiu R., (2017), *The Qualification of Electricity Production in High Efficiency Cogeneration for the Access to the Support Scheme through Green Certificates*. Problems of regional energetics, 2017, 3 (35), 58-68, Institute of Energy of the Academy of Sciences of Moldova, Chisinau, Republic of Moldova.
- **Atănăsoae P.**, Pentiu R., Hopulele E., Martin V., Tomuț A. (2017), *Determining the Amount of Electricity Generated in High Efficiency Cogeneration for the Access to the Support Scheme through Green Certificates*, The 7th “International Conference on Modern Power Systems” (MPS 2017), 6 – 9 June 2017, Cluj-Napoca.
- Project manager: **Atănăsoae P.** (2023-2026), Project no. 7829/18.04.2024; 7959/24.04.2023, *Monitoring energy efficiency in operation for the AMBRO Suceava cogeneration plant*.
- Project manager: **Atănăsoae P.** (2022), Project no. 27128/24.11.2022, *Analysis of the opportunity of a cogeneration - trigeneration plant in the painting process of metal products at ELECTRO ALFA CM Botoșani*.
- Project manager: **Atănăsoae P.** (2022), Project no. 9314/02.05.2022, *Self-assessment calculation and preparation of documentation for recording the cogeneration energy production of CHP AMBRO*.
- Project manager: **Atănăsoae P.** (2016), Project no. 918/20.01.2016, *Determination of the electricity produced in high-efficiency cogeneration, which can benefit from the support scheme through green certificates, of the Cogeneration Plant with ORC technology RIG Biomass Tarcău*.
- Project manager: **Atănăsoae P.** (2014), Project no. 1787/2357.14/30.01.2014, *Determination of the electricity produced in high-efficiency cogeneration, which can benefit from the support scheme through green certificates, of the Biomass Cogeneration Plant EGGER Romania Rădăuți*.

**Chapter 4** examines the participation of cogeneration plants in liberalized energy markets. In the case of cogeneration, the establishment of energy production costs has a specific particularity of the

simultaneous production, from the same installations, from the same form of primary energy and in close correlation, of two forms of final energy: heat and electricity. Participation in different electricity markets requires adapting the operation of cogeneration plants according to the revenue potential of these markets. To support the planning of the operation of cogeneration plants according to the revenue potential of electricity markets, the decision-making process must be thoroughly analysed. Operational strategies are needed to optimally allocate available capacities and participate in competitive markets to fully exploit this revenue potential. The main contributions in this direction are represented by the publication of 2 articles in WoS indexed journals, 4 articles published in specialized conference proceedings as first author and a research grant as project manager:

- **Atănăsoae P.** (2023), *Allocation of Joint Costs and Price Setting for Electricity and Heat Generated in Cogeneration*. *Energies* 2023, 16(1), 134.
- **Atănăsoae P.** (2018), *The Operating Strategies of Small-Scale Combined Heat and Power Plants in Liberalized Power Markets*. *Energies* 2018, 11(11), 3110.
- **Atănăsoae P.** (2016), *Determining the Operating Diagram for the Cogeneration Steam Turbines*. *Procedia Technology* 2016, 22, 797-802.
- **Atănăsoae P.** (2004), *Optimizing the operation of district heating turbines in non-nominal regimes*. 3rd National Conference on Classical and Nuclear Thermomechanical Equipment and Urban Energy (ETCN 2004), University Politehnica of Bucharest, 01 – 02 July 2004, pg.5-8, ISBN 973-7982-07-2.
- **Atănăsoae P., Dumitrescu O.** (2004), *The Burning Process Checking of the Steam Boilers with the Diagrams Help*. *Bulletin of the Polytechnic Institute of Iasi, tomul L(LIV), fasc. 5A, 2004, pg.205-208, ISSN 1223-8139.*
- **Atănăsoae P., Dumitrescu O.** (2002), *Following in Operation of the Steam Boilers Efficiency*. *Bulletin of the Polytechnic Institute of Iasi, tomul XLVIII (LII), fasc. 5A, 2002, pg.163-166, ISSN 0258-9109.*
- Project manager: **Atănăsoae P.** (2016), Project no. 4BG/01.10.2016; PN-III-P2-2.1-BG-2016-0038; Programme 2 - Increase Romanian economic competitiveness through research, development and innovation - Transfer of knowledge to the economic agent "Bridge Grant", *Increasing the energy efficiency of the cogeneration plant with ORC technology and biomass fuel RIG Biomass Tarcău.*

**Chapter 5** is focused on case studies on increasing the energy and economic efficiency of cogeneration systems. The main contributions in this direction are represented by the publication of 5 WoS indexed articles (of which four in journals with impact factor) and a research and development contract with the economic environment as project manager:

- **Atănăsoae P., Pentiu R.D., Milici L.D.** (2025) *High-Efficiency Cogeneration: A Viable Solution for the Decarbonization of Cities with District Heating Systems*. *Energies* 2025, 18(7), 1581.
- **Atănăsoae P., Pentiu R.D., Milici L.D.** (2022), *Opportunity Analysis of Cogeneration and Trigeneration Solutions: An Application in the Case of a Drug Factory*. *Energies* 2022, 15(8), 2737.
- **Atănăsoae P.** (2020), *Technical and Economic Assessment of Micro-Cogeneration Systems for Residential Applications*. *Sustainability* 2020, 12 (3), 1074.
- **Atănăsoae P.** (2020), *The Efficient Use of Natural Gas in Cogeneration Applications for Small Consumers*. *Procedia Manufacturing* 2020, 46, 364-369.
- Project manager: **Atănăsoae P.** (2019), Project no.4856/25.03.2019, *Analysis of the opportunity of a trigeneration plant at S.C. Balkan Pharmaceuticals S.R.L., Chisinau, Republic of Moldova.*

**Chapter 6** of the thesis presents the evolution and prospects of the teaching and research career with the main directions of professional career development. The main objectives pursued by the teaching and research activities are presented as well as the ways of correlating these activities. Special attention is paid to applied research projects and collaboration with the economic environment.

The own and general bibliographic references used are presented at the end of the habilitation thesis.