



CV - Dr. Martin Densing

Energy Economics Group (EEG)
Paul Scherrer Institute

Research Topics:

Electricity Market Modeling
Stochastic Hydropower Optimization
Stochastic Programming

Curriculum vitae

Martin Densing

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Personal information

Date of birth	July 27, 1970
Place of birth	Scherzingen, Switzerland
Nationality	Swiss
Marital status	relationship, one child

Employment

Jul 2009 –	Research Scientist at Energy Economics Group, open-time contract, Paul Scherrer Institute, Switzerland
May 2008 – Jun 2009	Freelance consultant (financial risk management). Customers: Swisscom IT Services Finance, retail banks in Switzerland and Liechtenstein
Jul 2006 – Apr 2008	Consultant at FIS Corp. (financial risk management)
Sep 1999 – Sep 2005	Research Assistant at Institute for Operations Research and Mathematical Methods in Economics (IOR), University of Zurich
1997 – Sep 1999	Consultant at Wolters-Kluwer Corp. (financial risk management)
1995 – 1996	Software Engineer (Martignoni Electronics Corp., Zürich)

Education, academic degrees

Dr. sc.	June 2007	Institute for Operations Research (IFOR), Department of Mathematics, ETH Zurich
MSc	Nov 1996	Theoretical Physics, ETH Zurich

Languages

German (native), English, French

Software Languages

GAMS (General Algebraic Modeling System), Mathematica, R, C, MatLab, SQL, VBA

Current research interests

Electricity market games (Nash-Cournot)

Stochastic programming problems for commodity (energy) storage, exact solutions

Multi-stage stochastic programming models for hydropower optimization

Multiperiod extensions of coherent risk measurement

Approximation methods of stochastic programming

Industrial/governmental projects

2017–2020 *SCCER-SoE (Swiss Competence Centers of Energy - Supply of Electricity) – Phase II*

- Work packages on Stochastic hydropower dispatch optimization and on Electricity market modeling
- Co-PI (acquisition leader of Energy Economics Group's part)

2015–2018 *PowerDesign - Swiss policy options for future electricity markets*

- Stochastic hydropower optimization for Switzerland under different Swiss and European market regimes, e.g. future capacity power markets.
- PI. Scientific research partner: Karlsruhe Institute of Technology (KIT)

2015–2017 *SwissHydropower*

- Market modeling and Risk-averse hydropower profit optimization using Multistage stochastic programming.
- PI. Scientific advisor: Elektrizitätswerke Zürich (EWZ)

2014–2017 *BEM: Bi-level electricity market modeling*

- Game-theoretic market model of Switzerland and of its surrounding countries; impact on price levels under different levels of market power
- PI. Scientific research partner: Chair of Quantitative Business Administration, University of Zurich.
- Scientific advisors: SFOE, electricity market specialists

2012–2017 *INSIGHT_E – EU energy consulting reports*

- Reports and briefs for the European Commission (INSIGHT_E, the so called think-tank for DG Energy in Brussels)
- PI (PSI's part). Scientific research partners: European Universities: UCL, UCC, KIT, KTH, Stuttgart

2013–2016 *SCCER-SoE (Swiss Competence Centers of Energy - Supply of Electricity) – Phase I*

- Lead author on PSI-report and on journal article on Swiss electricity scenario comparison.
- Analytical solutions of stochastic energy storage optimization problems

2014 *Comparison of Swiss Electricity Scenario Studies*. PI.

2013–2014 *National energy scenarios for New Zealand*

- Detailing the World Energy Council's global scenarios for New Zealand. PI

- 2012–2013 *Global energy scenarios* for the World Energy Council (WEC).
- Numerical implementation of the two WEC scenarios.
 - Data manipulation software for large-scale energy system modeling
 - Co-acquisition and contract-framing
- 2011 *Global mobility scenarios for the World Energy Council.*
- Numerical implementation of World Energy Council’s “Tollway” and “Freeway” mobility scenarios. Co-PI.
- 2010–2011 *Global mobility scenarios for Volkswagen AG*

Other research collaboration

University of Vienna, Dep. of Statistics and Operations Research & TU Wien, Operations Research and Control Systems: Book chapter, Invitation to colloquiums and conferences, Organizing conference sessions, Session chair

Karlsruhe Institute of Technology: Joint funded project

University of Zurich, Chair of Quantitative Business Administration: Joint publication and conference presentation, Joint funded project (see above)

University of Basel, Energy Economics: Combined workshop on electricity market-model development, Data exchange on electricity supply and demand models

University of Bergamo: Book Chapter, Invitation to conferences

Norwegian University of Science and Technology: Invitation to conferences and workshops, Invitation to PSI, Talk at PSI

University of St. Gallen. Institute for Operations Research and Computational Finance: Invitation to conferences and workshops

Energy Science Center, ETH: Scientific advisor for AFEM Project

Teaching

- 2017 *Mean-Risk Optimization.* Spring semester 2017 (Feb–Jun). Full master’s course, 2 hours weekly (3 ECTS points), incl. exercises and final exam. Faculty of Business, Economics and Informatics, University of Zurich, <https://studentservices.uzh.ch/uzh/anonym/vvz/index.html#/details/2016/004/S/M/50821177>
- 2012 Training course for company Saudi Aramco on energy systems modeling.
- 2000–2005 Exercises for courses Linear Programming, Nonlinear Programming; Seminar on OR application (on a continuous basis during employment as research assistant at University of Zurich)

Supervision (selection)

- 2014–2017 ETH PhD thesis on decentralized and renewable heat and electricity for communities in Switzerland (CCEM, IDEAS4Cities)
- 2013–2017 ETH PhD thesis on multi-objective optimization with life-cycle objectives in

2016 energy systems modeling. Defended on
MSc thesis (University of Zurich): Empirical Analysis of Demand and Supply
Curves of Electricity Prices in Europe

Other activities

Financial auditor of the Swiss Operations Research Society (SVOR)
Referee's reports for: OR Spectrum, European Journal of Operational Research, Energy
Journal, Journal of Commodity Markets

Memberships in professional societies

Swiss Operations Research Society (SVOR)
Mathematical Optimization Society (MOS)
International Association for Energy Economics (IAEE)

Publications

Peer-reviewed papers

Yazdanie, M., Densing, M., Wokaun, A. (2017). Cost optimal urban energy systems planning in the context of national energy policies: A case study for the city of Basel, *Energy Policy*, Vol. 110, pp. 176–190, [doi: 10.1016/j.enpol.2017.08.009](https://doi.org/10.1016/j.enpol.2017.08.009)

Densing, M., Panos, E., Hirschberg, S. (2016). Meta-Analysis of Energy Scenario Studies: Example of Electricity Scenarios for Switzerland, *Energy*, 109, pp. 998–1015, [doi: 10.1016/j.energy.2016.05.020](https://doi.org/10.1016/j.energy.2016.05.020)

Yazdanie, M., Densing, M., Wokaun, A. (2016). The Role of Decentralized Generation and Storage Technologies in Future Energy Systems Planning for a Rural Agglomeration in Switzerland, *Energy Policy*, 96, pp. 432–445, [doi: 10.1016/j.enpol.2016.06.010](https://doi.org/10.1016/j.enpol.2016.06.010)

Panos, E., Densing, M., Volkart, K. (2016). Access to electricity in the World Energy Council's global energy scenarios: An outlook for developing regions until 2030, *Energy Strategy Reviews*, 9, pp. 28–49, Elsevier [doi:10.1016/j.esr.2015.11.003](https://doi.org/10.1016/j.esr.2015.11.003)

Panos, E., Turton, H., Densing, M., Volkart, K. (2015). Powering the growth of Sub-Saharan Africa: The Jazz and Symphony scenarios of World Energy Council, *Energy for Sustainable Development*, 26, pp. 14–33, Elsevier [doi:10.1016/j.esd.2015.01.004](https://doi.org/10.1016/j.esd.2015.01.004)

Densing, M. (2014). Stochastic programming of time-consistent extensions of AVaR, *SIAM Journal on Optimization*, 24(3), pp. 993–1010, [doi:10.1137/130905046](https://doi.org/10.1137/130905046)

Densing, M. (2013). Dispatch Planning using Newsvendor Dual Problems and Occupation

Times: Application to Hydropower, *European Journal of Operational Research*, 228, pp. 321–330, [doi: 10.1016/j.ejor.2013.01.033](https://doi.org/10.1016/j.ejor.2013.01.033)

Densing, M., Mayer, J. (2012). Multiperiod Stochastic Optimization Problems with Time-Consistent Risk Constraints, *Operations Research Proceedings 2011*, Klatte D., Lüthi H.-J., Schmedders K. (ed.), Springer, 2012, pp. 521–526. [doi: 10.1007/978-3-642-29210-1_83](https://doi.org/10.1007/978-3-642-29210-1_83)

Densing, M., Turton, H., Bäuml, G. (2012). Conditions for the successful deployment of electric vehicles - a global energy system perspective, *Energy*, 47, pp. 137–149, [doi: 10.1016/j.energy.2012.09.011](https://doi.org/10.1016/j.energy.2012.09.011)

Densing, M. (2012). Occupation times of the Ornstein–Uhlenbeck process: Functional PCA and evidence from electricity prices, *Physica A*, 391 (23), pp. 5818–5826, [doi: 10.1016/j.physa.2012.07.040](https://doi.org/10.1016/j.physa.2012.07.040)

Invited contributions in books

Kathrin, V., Densing, M., Pye, S., Rocco, M., Badouard, T. et al. (2017). Chapter on Hydrogen Pathways for Stationary Applications, in Welsch, M. et al (ed.) *Europe's Energy Transition - Insights for policy making*, Elsevier Science & Technology Books, ISBN 978-0-12-809806-6, 28. April 2017

Densing, M. (2013). Price-Driven Hydropower Dispatch Under Uncertainty, in Kovacevic, R., Pflug, G. & Vespucci, M. T. (ed.), *Chapter 4, Handbook of Risk Management in Energy Production and Trading*, pp. 73–104, International Series in Operations Research & Management Science, Springer, [doi: 10.1007/978-1-4614-9035-7_4](https://doi.org/10.1007/978-1-4614-9035-7_4)

Other publications

Volkart, K., De Miglio, R., Densing, M., Priem, T., Pye, S. (2016). Assessments of the Merit of Different Hydrogen and Fuel Cell Pathways for Energy Applications. *INSIGHT_E Policy Report*, 7th Framework Programme of the European Commission, www.insightenergy.org

Campbell, D., Densing M., Panos E., et al. (2015). New Zealand Energy Scenarios – Navigating energy futures to 2050, *World Energy Council, BusinessNZ Energy Council*, New Zealand, http://www.bec.org.nz/_data/assets/pdf_file/0014/110309/BEC-Report.pdf

Densing, M., Hirschberg, S., Turton, H. (2014). Review of Swiss Electricity Scenarios 2050, *PSI-Report, 14-05*, Paul Scherrer Institute, ISSN 1019-0643, https://www.psi.ch/eem/PublicationsTabelle/PSI-Bericht_14-05.pdf

Bauer, C., Densing, M., Turton, H. et al. (2013). A glimpse into the future, *Energie-Spiegel (Energy Mirror) No. 22*, Paul Scherrer Institute. ISSN 1661-5107, http://www.psi.ch/eem/PublicationsTabelle/2013_energiespiegel_e.pdf

Frei, C., Turton, H., Densing, M., Panos, E., Volkart, K. et al. (2013). World Energy Scenarios – Composing energy futures to 2050, Project Partner Paul Scherrer Institute (PSI),

Switzerland. *World Energy Council*, London, ISBN 978-0-946121-33-5,
<https://www.worldenergy.org/publications/2013/world-energy-scenarios-composing-energy-futures-to-2050/>

Turton, H., Panos, E., Densing, M., Volkart, K. (2013). Global Multi-regional MARKAL (GMM) model update: Disaggregation to 15 regions and 2010 recalibration, *PSI-Report, 13-03*, Paul Scherrer Institute, ISSN 1019-0643,
https://www.psi.ch/eem/PublicationsTabelle/PSI-Bericht_13-03.pdf

Frei, C., Turton, H., Densing, M., et al. (2011). Global Transport Scenarios 2050, *World Energy Council*, London, ISBN 978-0-946121-14-4/978-0-946121-13-7
https://www.worldenergy.org/wp-content/uploads/2012/09/wec_transport_scenarios_2050.pdf

External Presentations

Densing, M., Panos, E., Schmedders, K. (2017). Stochastic bi-level electricity market modeling, *2nd Workshop of SET-Nav WP10 Modelling Forum - Modelling of Risk & Uncertainty in Energy System (with panel session)*, **invited talk**, ETH, Zürich, Switzerland

Densing, M. (2016). Stopped AVaR: A multiperiod extension of the risk measure AVaR, with application in power optimization, *14th Triannual International Conference on Stochastic Programming (ICSP 2016)*, **invited talk**, Búzios, Brazil

Densing, M., Panos, E., Schmedders, K. (2016). Oligopolistic Capacity Expansion with subsequent Market Bidding under Transmission constraints: Case of Switzerland and surrounding countries, *BFE-EWG Research Project Workshop (Swiss Federal Office of Energy – Energy-Economy-Society)*, ETH, Zürich, Switzerland

Densing, M., Panos, E. (2016). BEM – Bi-level electricity market modeling. *Joint workshop with chair of energy economics of UniBasel and SFOE*, University of Basel, Switzerland

Densing, M., Panos, E., Schmedders, K. (2015). Decision making in electricity markets: Bi-level games and stochastic programming, *Energy Science Center Workshop*, **invited talk**, ETH, Zürich Switzerland,
https://www.psi.ch/eem/ConferencesTabelle/BilevelAndSP_MartinDensing_TALK.pdf

Densing, M., Panos, E., Schmedders, K. (2015). Bilevel oligopolistic electricity market models: The case of Switzerland and surrounding countries, *Triannual International Conference of the Operations Research Societies of Germany, Switzerland and Austria (OR 2015)*, **invited talk, session organizer**, Vienna, Austria

Densing M. (2015). Stochastic programming formulations of coherent multi-period risk measurement, *13th Swiss Operations Research Days*, IBM Research, Rüschlikon, Switzerland

Densing, M., Hirschberg, S., Panos, E. (2015). Future Energy Scenarios, *4th International Congress on Sustainability and Engineering (ICOSSE 2015)*, **invited key note talk**, Balatonfüred, Hungary

Densing, M., Hirschberg, S. (2014). Swiss Electricity Scenarios 2050, *Colloquium at Institute of Science, Technology and Policy (ISTP, Prof. S. Hellweg)*, **invited talk**, ETH, Zürich, Switzerland

Densing, M. (2014). Price-Duration Curves: Decomposition and integration into hydropower optimization models, *3rd Asset Optimization Day (AOD 2014, organized by BKW Energy)*, **invited talk**, Bern, Switzerland

Densing, M. (2014). Hydropower optimization against the market: Generalizations of the newsvendor problem, *4th Energy Finance Christmas Workshop (EFC 14)*, **invited talk**, University of St. Gallen, Switzerland

Densing, M. (2014). Pumped-storage hydropower optimization: Effects of several reservoirs and of ancillary services, *20th Triannual Conference of the International Federation of Operational Research Societies (IFORS 2014)*, **invited talk**, Barcelona, Spain, https://www.psi.ch/eem/ConferencesTabelle/2014_IFORS_reduced_Densing.pdf

Densing, M. (2013). Price-driven hydropower dispatch under uncertainty, *Workshop on Risk Management in Energy Production and Trading*, **invited talk**, University of Vienna, Austria, <http://energybook.univie.ac.at/>

Densing, M., Turton, H., Panos, E., Volkart, K. (2013). Global Energy Scenarios 2050, *32th International Energy Workshop (IEW)*, Paris, France, https://www.psi.ch/eem/ConferencesTabelle/2013_densing_iew.pdf

Densing, M., Turton, H., Panos, E., Volkart, K. (2013). Energieszenarien bis 2050: Jazz und Symphony, *Rotary Club*, **invited talk**, Brugg, Switzerland

Densing, M., Turton, H., Panos, E., Volkart, K. (2013). Welt-Energieszenarien 2050, *Workshop on: Berichterstattung über den 22. Weltenergiekongress in Daegu 2013 durch den Schweizer Energierat. Energy Science Center*, **invited talk**, ETH, Zürich, Switzerland

Densing, M., H. Turton, Bäuml, G. (2012). Conditions for the deployment of alternative drivetrains: An energy system perspective, *12th European Energy Conference of the International Association for Energy Economics (IAEE)*, Venice, Italy, https://www.psi.ch/eem/ConferencesTabelle/2012_densing_iaee.pdf

Densing, M., Turton H., Bäuml, G. (2012). Conditions for the successful deployment of electric vehicles, *12th Swiss Transport Research Conference*, Ascona, Switzerland, https://www.psi.ch/eem/ConferencesTabelle/2012_densing_ascona.pdf

Densing, M., Mayer, J. (2012). Multistage stochastic optimization of power dispatch and multiperiod duality of CVaR, *21st International Symposium on Mathematical Programming (ISMP 2012)*, **invited talk**, Berlin, Germany, https://www.psi.ch/eem/ConferencesTabelle/2012_densing_ism.pdf

Densing, M. (2012). Stochastic programming formulations of coherent multiperiod risk measurement, *25th European Conference on Operational Research (EURO 2012)*, **invited talk**, Vilnius, Lithuania, https://www.psi.ch/eem/ConferencesTabelle/2012_densing_euro.pdf

Densing, M. (2012). Multiperiod stochastic optimization problems with time-consistent risk constraints and an application to power generation scheduling, *Institute of Statistics and Operations Research of the University of Vienna (ISOR Colloquium)*, **invited talk**, Vienna, Austria

Densing, M., Mayer, J. (2011). Multiperiod Stochastic Optimization Problems with Time-Consistent Risk Constraints, *International Conference on Operations Research (OR 2011)*, **invited talk**, Zürich, Switzerland

Densing, M. (2007). Multiperiod risk measurement and optimal scheduling of electricity generation, *11th International Conference on Stochastic Programming (SPXI)*, Vienna, Austria

Densing, M. (2004). Approaches to multiperiod coherent risk measurement. *International Conference on Computational Management Science (CMS04)*, Neuchâtel, Switzerland

Other Conference Contributions

Yazdanie, M., Densing, M. (2017). The Role of Decentralized Generation and Storage Technologies in the Future Energy Systems of Swiss Communities, *INSMART - Integrative Smart City Planning (Final Conference)*, Brussels, Belgium

Densing, M., Kober, T. (2016). Exact dispatch solutions of stochastic hydropower problems (poster), *SCCER-Supply of Electricity Annual Conference 2016*, Sion, Switzerland

Volkart, K., Densing, M., Panos, E., Mutel, C., Sabio, N., Strachan, N. (2016). Implementation of multi-objective optimization in the MARKAL framework for simultaneously analysing the economic, societal and environmental performance of the global energy system, *wholeSEM Annual Conference 2016*, Cambridge, UK

Volkart, K., Panos, E., Densing, M. (2015). Review of Global Energy Scenarios (poster), *SCCER-Supply of Electricity Annual Conference 2015*, Neuchâtel, Switzerland

Densing, M., Panos, E., Turton, H., Hirschberg, S. (2015). Review and Meta-Analysis of Swiss Electricity Scenarios 2050 (poster), *SCCER-Supply of Electricity Annual Conference 2015*, Neuchâtel, Switzerland

Panos, E., Densing, M., Volkart, K. (2015). Achieving universal electricity access by 2030 in a sustainable way, *34rd International Energy Workshop (IEW 2015)*, Abu Dhabi, UAE

Panos, E., Densing, M., Turton, H., Volkart, K. (2014). Orchestrating or improvising the global energy transition: Scenario modelling with the World Energy Council, *33rd International Energy Workshop (IEW 2014)*, Beijing, China

Panos, E., Densing, M., Turton, H., Volkart, K. (2014). Choosing a tempo to power Sub-Saharan Africa in 2050: Jazz and Symphony scenarios of the World Energy Council, *33rd International Energy Workshop (IEW 2014)*, Beijing, China

Turton, H., Densing, M., Panos, E., Volkart, K. (2013). World Energy Scenarios Composing energy futures to 2050 – PSI Methodology, *Swiss Energy Council's reporting from the 22nd World Energy Congress in Daegu 2013*, Energy Center, EPFL, Lausanne, Switzerland

PhD Thesis

Densing, M. (2007). *Hydro-Electric Power Plant Dispatch-Planning - Multi-Stage Stochastic Programming with Time-Consistent Constraints on Risk*, ETH Zurich, 2007, No.17244, [doi: 10.3929/ethz-a-005464814](https://doi.org/10.3929/ethz-a-005464814). Referees: Peter Kall, Hans-Jakob Lüthi.

Master Thesis (grade: 6.0)

Densing, M. (1996). *Numerical Stability Analysis of Globally Regular Solutions of the Einstein-Yang-Mills-Dilaton-Proca-System*, University of Zurich (available on request). Examiner: Norbert Straumann.