Magnus Fröhling
Chair of Circular Economy and Sustainability Assessment

Qualifications

Habilitation, venia legendi: "Business Administration", Karlsruhe Institute of Technology (KIT)
1 Jun 2006 → 14 Dec 2011
Award Date: 14 Dec 2011

Management and Technology, PhD, Dr.rer.pol., Karlsruhe Institute of Technology (KIT)
1 Jan 2001 → 19 Dec 2005
Award Date: 19 Dec 2005

Management and Technology, Industrial Engineering and Management (Diploma), Karlsruhe Institute of Technology (KIT)
1 Oct 1995 → 28 Nov 2000
Award Date: 28 Nov 2000

Employment

Chair of Circular Economy and Sustainability Assessment
Technical University of Munich
1 Sep 2018 → present

Professor of Business Administration, esp. Resource Management
TU Bergakademie Freiberg (TUBAF)
Germany
1 Sep 2015 → 31 Aug 2018

Academic Counselor and Research Group Lead
Karlsruhe Institute of Technology (KIT)
1 Aug 2006 → 31 Aug 2015

Research Associate and PhD student
Karlsruhe Institute of Technology (KIT)
1 Jan 2001 → 31 Jul 2006

Research outputs

Advancing circularity in a Chilean neighborhood through the water-waste-energy nexus: A stakeholder analysis
Bolivar, V., Poganietz, W. R. & Fröhling, M., Jan 2025, In: Resources, Conservation and Recycling. 212, 107986.

Designing circular and sustainable low-cost, low-weight, high-performance (LLH) products for hospitals – A life cycle assessment of FFP2 mask design configurations
Klose, S. & Fröhling, M., Jan 2025, In: Resources, Conservation and Recycling. 212, 108012.

Conceptualizing circular economy policy instruments: The case of recycled content standards
Maeder, M. & Fröhling, M., Dec 2024, In: Sustainable Production and Consumption. 52, p. 333-346 14 p.

Green light for bidirectional charging? Unveiling grid repercussions and life cycle impacts
Wohlschlager, D., Reinhard, J., Stierlen, I., Neitz-Regett, A. & Fröhling, M., Dec 2024, In: Advances in Applied Energy. 16 , 100195.

Unpacking the path toward a sustainable circular economy through industrial ecology
Fröhling, M., Aoki-Suzuki, C., Bakshi, B., Leipold, S., Tong, X., Wang, H. S. H. & Wiedenhofer, D., Dec 2024, In: Journal of Industrial Ecology. 28, 6, p. 1359-1361 3 p.

Environmental effects of vehicle-to-grid charging in future energy systems – A prospective life cycle assessment
Wohlschlager, D., Kigle, S., Schindler, V., Neitz-Regett, A. & Fröhling, M., 15 Sep 2024, In: Applied Energy. 370, 123618.

Decarbonization potential and economic viability of chemical recycling for China's transformation towards carbon neutrality: Case analysis of global warming potential and costs of municipal solid waste gasification for methanol production
Voss, R., Lee, R. P., Keller, F., Huang, Q. & Fröhling, M., Jul 2024, In: Resources, Conservation and Recycling. 206, 107613.

Assessing the environmental impacts of product-service systems – the case of washing machines in Germany
Otterbach, N. & Fröhling, M., May 2024, In: Resources, Conservation and Recycling. 204, 107446.

The Preferability Framework - Enabling life cycle sustainability assessment meta studies
Huber, J. & Fröhling, M., May 2024, In: Sustainable Production and Consumption. 46, p. 96-107 12 p.

A Multi-level Resource Circularity Index based in the European Union's Circular Economy Monitoring Framework
de Souza, V. M., Fröhling, M. & Pigosso, D. C. A., Feb 2024, In: Waste and Biomass Valorization. 15, 2, p. 615-636 22 p.

Integration of blockchain and life cycle assessment: a systematic literature review
Zhang, L. & Fröhling, M., 2024, (Accepted/In press) In: International Journal of Life Cycle Assessment.

Overcoming challenges in life cycle assessment of smart energy systems – A map of solution approaches
Wohlschlager, D., Bluhm, H., Beucker, S., Pohl, J. & Fröhling, M., 15 Oct 2023, In: Journal of Cleaner Production. 423, 138584.

A consequential approach to life cycle sustainability assessment with an agent-based model to determine the potential contribution of chemical recycling to UN Sustainable Development Goals
Voss, R., Lee, R. P. & Fröhling, M., Jun 2023, In: Journal of Industrial Ecology. 27, 3, p. 726-745 20 p.

Cost versus environment? Combined life cycle, techno-economic, and circularity assessment of silicon- and perovskite-based photovoltaic systems
Bartie, N., Cobos-Becerra, L., Mathies, F., Dagar, J., Unger, E., Fröhling, M., Reuter, M. A. & Schlatmann, R., Jun 2023, In: Journal of Industrial Ecology. 27, 3, p. 993-1007 15 p.

Chemical Recycling of Plastic Waste: Comparative Evaluation of Environmental and Economic Performances of Gasification- and Incineration-based Treatment for Lightweight Packaging Waste
Voss, R., Lee, R. P. & Fröhling, M., Dec 2022, In: Circular Economy and Sustainability. 2, 4, p. 1369-1398 30 p.

Metallurgical infrastructure and technology criticality: the link between photovoltaics, sustainability, and the metals industry
Bartie, N., Cobos-Becerra, L., Fröhling, M., Schlatmann, R. & Reuter, M., Dec 2022, In: Mineral Economics. 35, 3-4, p. 503-519 17 p.

Proposal of a Dual Circularity Concept for Sustainable Design
Metic, J., Klose, S., McAloone, T. C., Fröhling, M. & Pigosso, D. C. A., May 2022, In: Proceedings of the Design Society. 2 , p. 1051-1060 10 p.

CirculaTUM – the TUM Alliance for Circular Economy in Research, Education and Transfer
Fottner, J., Fröhling, M., Heinrich, V. & Mauß, N. A., 2022, *Circular Economy.* Reichwald, R., Fröhling, M., Herbst-Gaebel, B., Molls, M. & Wilderer, P. (eds.). München: TUM University Press, p. 109-113 5 p. (TUM Forum Sustainability).

Global warming potential and economic performance of gasification-based chemical recycling and incineration pathways for residual municipal solid waste treatment in Germany
Voss, R., Lee, R. P., Seidl, L., Keller, F. & Fröhling, M., Oct 2021, In: Waste Management. 134, p. 206-219 14 p.

Process simulation and digitalization for comprehensive life-cycle sustainability assessment of Silicon photovoltaic systems
Bartie, N., Cobos-Becerra, L., Frohling, M., Reuter, M. A. & Schlatmann, R., 20 Jun 2021, *2021 IEEE 48th Photovoltaic Specialists Conference, PVSC 2021.* Institute of Electrical and Electronics Engineers Inc., p. 1244-1249 6 p. (Conference Record of the IEEE Photovoltaic Specialists Conference).

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Review of the terminology in the sustainable building sector
Rheude, F., Kondrasch, J., Röder, H. & Fröhling, M., 1 Mar 2021, In: Journal of Cleaner Production. 286, 125445.

The simulation-based analysis of the resource efficiency of the circular economy–the enabling role of metallurgical infrastructure
Bartie, N. J., Abadías Llamas, A., Heibeck, M., Fröhling, M., Volkova, O. & Reuter, M. A., 2 Apr 2020, In: Mineral Processing and Extractive Metallurgy: Transactions of the Institute of Mining and Metallurgy. 129, 2, p. 229-249 21 p.

Preface
Fröhling, M. & Hiete, M., 2020, In: Advances in biochemical engineering/biotechnology. 173, p. v

Sustainability and life cycle assessment in industrial biotechnology: a review of current approaches and future needs
Fröhling, M. & Hiete, M., 2020, *Advances in Biochemical Engineering/Biotechnology.* Springer, p. 143-203 61 p. (Advances in Biochemical Engineering/Biotechnology; vol. 173).

The sustainability and life cycle assessments of industrial biotechnology: an introduction
Fröhling, M. & Hiete, M., 2020, *Advances in Biochemical Engineering/Biotechnology.* Springer, p. 3-9 7 p. (Advances in Biochemical Engineering/Biotechnology; vol. 173).

Predictive and flexible circular economy approaches for highly integrated products and their materials as given in e-mobility and ICT
Knieke, C., Lawrenz, S., Fröhling, M., Goldmann, D. & Rausch, A., 2019, *E-Mobility and Circular Economy.* Peuker, U. A., Reuter, M., Goldmann, D. & Kratzsch, R. (eds.). Trans Tech Publications Ltd, p. 22-31 10 p. (Materials Science Forum; vol. 959 MSF).

Assessing potentials for mobile/smartphone reuse/remanufacture and recycling in Germany for a closed loop of secondary precious and critical metals
Gurita, N., Fröhling, M. & Bongaerts, J., 1 Jul 2018, In: Journal of Remanufacturing. 8, 1-2, p. 1-22 22 p.

Chemo-Enzymatic Epoxidation of Lallemantia IbericaSeed Oil: Process Development and Economic-Ecological Evaluation
Haitz, F., Radloff, S., Rupp, S., Fröhling, M., Hirth, T. & Zibek, S., 1 May 2018, In: Applied Biochemistry and Biotechnology. 185, 1, p. 13-33 21 p.

Modeling the impact of competing utilization paths on biomass-to-liquid (BtL) supply chains
Zimmer, T., Rudi, A., Müller, A. K., Fröhling, M. & Schultmann, F., 15 Dec 2017, In: Applied Energy. 208, p. 954-971 18 p.

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Assessing social risks of global supply chains: A quantitative analytical approach and its application to supplier selection in the German automotive industry
Zimmer, K., Fröhling, M., Breun, P. & Schultmann, F., 15 Apr 2017, In: Journal of Cleaner Production. 149, p. 96-109 14 p.

Future perspectives for WEEE recycling-Dynamic evaluation of the mobile phones and smartphones waste stream
Gurita, N., Frohling, M. & Bongaerts, J., 23 Jan 2017, *2016 Electronics Goes Green 2016+, EGG 2016.* Institute of Electrical and Electronics Engineers Inc., 7829828. (2016 Electronics Goes Green 2016+, EGG 2016).

Analyzing investment strategies under changing energy and climate policies: an interdisciplinary bottom-up approach regarding German metal industries
Breun, P., Fröhling, M., Zimmer, K. & Schultmann, F., 1 Jan 2017, In: Journal of Business Economics. 87, 1, p. 5-39 35 p.

Design and planning of a closed-loop supply chain with three way recovery and buy-back offer
Dutta, P., Das, D., Schultmann, F. & Fröhling, M., 1 Nov 2016, In: Journal of Cleaner Production. 135, p. 604-619 16 p.

Freight transportation planning considering carbon emissions and in-transit holding costs: a capacitated multi-commodity network flow model
Rudi, A., Fröhling, M., Zimmer, K. & Schultmann, F., 1 Jun 2016, In: EURO Journal on Transportation and Logistics. 5, 2, p. 123-160 38 p.

Sustainable supplier management - A review of models supporting sustainable supplier selection, monitoring and development
Zimmer, K., Fröhling, M. & Schultmann, F., 3 Mar 2016, In: International Journal of Production Research. 54, 5, p. 1412-1442 31 p.

Combined scheduling and capacity planning of electricity-based ammonia production to integrate renewable energies
Schulte Beerbühl, S., Fröhling, M. & Schultmann, F., 16 Mar 2015, In: European Journal of Operational Research. 241, 3, p. 851-862 12 p.

Assessment of an organosolv lignocellulose biorefinery concept based on a material flow analysis of a pilot plant
Laure, S., Leschinsky, M., Fröhling, M., Schultmann, F. & Unkelbach, G., 1 Oct 2014, In: Cellulose Chemistry and Technology. 48, 9-10, p. 793-798 6 p.

Livestock manure and crop residue for energy generation: Macro-assessment at a national scale
Bidart, C., Fröhling, M. & Schultmann, F., Oct 2014, In: Renewable and Sustainable Energy Reviews. 38, p. 537-550 14 p.

Assessing the integration of torrefaction into wood pellet production
Mobini, M., Meyer, J. C., Trippe, F., Sowlati, T., Fröhling, M. & Schultmann, F., 1 Sep 2014, In: Journal of Cleaner Production. 78, p. 216-225 10 p.

Electricity and substitute natural gas generation from the conversion of wastewater treatment plant sludge
Bidart, C., Fröhling, M. & Schultmann, F., Jan 2014, In: Applied Energy. 113, p. 404-413 10 p.

A Material Flow-based Approach to Enhance Resource Efficiency in Production and Recycling Networks
Fröhling, M., Schwaderer, F., Bartusch, H. & Schultmann, F., Feb 2013, In: Journal of Industrial Ecology. 17, 1, p. 5-19 15 p.

Comprehensive techno-economic assessment of dimethyl ether (DME) synthesis and Fischer-Tropsch synthesis as alternative process steps within biomass-to-liquid production
Trippe, F., Fröhling, M., Schultmann, F., Stahl, R., Henrich, E. & Dalai, A., Feb 2013, In: Fuel Processing Technology. 106 , p. 577-586 10 p.

Municipal solid waste and production of substitute natural gas and electricity as energy alternatives
Bidart, C., Fröhling, M. & Schultmann, F., 2013, In: Applied Thermal Engineering. 51, 1-2, p. 1107-1115 9 p.

Ressourceneffizienzpotenziale von Innovationen in rohstoffnahen Produktionsprozessen
Albrecht, S., Bollhöfer, E., Brandstetter, P., Fröhling, M., Mattes, K., Ostertag, K., Peuckert, J., Seitz, R., Trippe, F. & Woidasky, J., Oct 2012, In: Chemie-Ingenieur-Technik. 84, 10, p. 1651-1665 15 p.

Analyzing energy and resource efficiency measures in the steel and zinc industry combining flowsheet simulation with a linear material and energy flow model
Fröhling, M., Schwaderer, F., Bartusch, H. & Schultmann, F., Jan 2012, In: Revue de Metallurgie. Cahiers D'Informations Techniques. 109, 5, p. 359-367 9 p.

Economic and ecological assessment of biorefineries – Findings of the German biorefinery roadmap process
Fritsche, U. R., Fröhling, M., Gerlach, J., Gröngröft, A., Günther, A., Günther, J., Kamm, B., Klenk, I., Laure, S., Meyer, J. C., Schweinle, J., Stichnothe, H., Strohm, K., Trippe, F., Peters, D. & Wagemann, K., 2012, p. 104-108. 5 p.

Techno-economic assessment of gasification as a process step within biomass-to-liquid (BtL) fuel and chemicals production
Trippe, F., Fröhling, M., Schultmann, F., Stahl, R. & Henrich, E., Nov 2011, In: Fuel Processing Technology. 92, 11, p. 2169-2184 16 p.

Logistics of Renewable Raw Materials
Fröhling, M., Schweinle, J., Meyer, J. C. & Schultmann, F., 7 Apr 2011, *Renewable Raw Materials: New Feedstocks for the Chemical Industry.* Wiley-VCH, p. 49-94 46 p.

Impact of recycling measures on resource- and energy efficiency and greenhouse gas emissions in the iron, steel and zinc industry
Bartusch, H., Schwaderer, F., Alcalde, A. M. F., Fröhling, M. & Schultmann, F., 2011, *Proceedings - European Metallurgical Conference, EMC 2011.* p. 1539-1552 14 p. (Proceedings - European Metallurgical Conference, EMC 2011; vol. 5).

Integrated planning of transportation and recycling for multiple plants based on process simulation
Fröhling, M., Schwaderer, F., Bartusch, H. & Rentz, O., 1 Dec 2010, In: European Journal of Operational Research. 207, 2 , p. 958-970 13 p.

Techno-economic analysis of fast pyrolysis as a process step within biomass-to-liquid fuel production
Trippe, F., Fröhling, M., Schultmann, F., Stahl, R. & Henrich, E., Dec 2010, In: Waste and Biomass Valorization. 1, 4, p. 415-430 16 p.

A case study on raw material blending for the recycling of ferrous wastes in a blast furnace
Fröhling, M. & Rentz, O., Jan 2010, In: Journal of Cleaner Production. 18, 2, p. 161-173 13 p.

An integrated approach to enhance energy and resource efficiency and reduce greenhouse gas emissions in the iron, steel and zinc industry
Fröhling, M., Bartusch, H., Schwaderer, F. & Rentz, O., 2009, *Proceedings - European Metallurgical Conference, EMC 2009.* p. 53-68 16 p. (Proceedings - European Metallurgical Conference, EMC 2009; vol. 1).

An inter-company approach to improve resource and energy efficiency and reduce greenhouse gas emissions in metal industries by linking flow sheet models
Frohling, M., Bartusch, H., Schwaderer, F. & Schultmann, F., 2009, In: World of Metallurgy - ERZMETALL. 62, 5, p. 288-298 11 p.

A methodical approach for the techno-economic and ecological evaluation of the value chain of biorefineries
Fröhling, M., Haase, M. & Rentz, O., 2008, *2008 Nordic Wood Biorefinery Conference, NWBC 2008 - Proceedings.* STFI, p. 202-203 2 p. (2008 Nordic Wood Biorefinery Conference, NWBC 2008 - Proceedings).

Otello - Entwicklung eines integrated assessment modells für ein nationales emissionsmanagement
Fröhling, M., Hiete, M., Rentz, O., Rebecca Ilsen, R., Comes, T. & Rentz, O., 2008, *VDI Berichte.* 2035 ed. p. 241-245 5 p. (VDI Berichte; no. 2035).

Stoffliche, energetische und ökologische bewertung einer prozesskette zur herstellung von synthetischen biokraftstoffen
Fröhling, M., Kerdoncuff, P. & Rentz, O., Sep 2007, Chemie-Ingenieur-Technik, 79, 9, p. 1455-1456 2 p.

Enhancement of energy and resource efficiency and reduction of greenhouse gas emissions in the iron and steel industry and the zinc industry
Fröhling, M., Bartusch, H. & Rentz, O., 2007, *Proceedings - European Metallurgical Conference, EMC 2007.* p. 2036-2037 2 p. (Proceedings - European Metallurgical Conference, EMC 2007; vol. 4).

Fuzzy approach for production planning and detailed scheduling in paints manufacturing
Schultmann, F., Fröhling, M. & Rentz, O., 15 Apr 2006, In: International Journal of Production Research. 44, 8, p. 1589-1612 24 p.

Demontageplanung und -steuerung mit Enterprise-Resource- und Advanced-Planning-Systemen
Schultmann, F., Fröhling, M. & Rentz, O., 2002, In: Wirtschaftsinformatik. 44, 6, p. 557-565 9 p.

Prizes

TUM Sustainability Award 2021
Fröhling, M. (Recipient) & Fottner, J. (Recipient), 2 Dec 2021

Projects

BioReSt: BioReSt: Preparation of a Bavarian Resource Strategy - Scientific Foundations and Recommendations
Fröhling, M. (PI) & Weber-Blaschke, G. (PI)
1/04/21 → 30/09/24

Biotenside Alliance: Functionally optimised biotensides based on regionally available raw materials produced with optimised biotechnological processes
Fröhling, M. (PI)
1/01/18 → 28/02/21

Car2Car: Car2Car: Closed-loop recycling concepts for end-of-life vehicles
Fröhling, M. (PI), Mayr, P. (PI) & Fottner, J. (PI)
1/01/23 → 31/12/25

ECOMO: Electrobiocatalytic cascade for bulk reduction of CO2 to CO coupled to fermentative production of high value diamine monomers
Fröhling, M. (PI)
1/11/23 → 31/10/26

FaCE: FaCE: Facilitating the Circular Economy with Distributed Ledger Technology
Fröhling, M. (PI)
1/10/22 → 30/09/26

FleWoKo: FleWoKo: Planning and assessment of flexibel residential concepts for different life cycle phases built with wood
Fröhling, M. (PI) & Menrad, K. (PI)
1/01/21 → 30/09/24

FUMA: FuMa: Functional optimised face masks for protection against infection and contamination
Fröhling, M. (PI) & Prazeres da Costa, C. (PI)
1/04/21 → 30/09/24

FSCM: Future Sustainable Car Materials
Fröhling, M. (PI), Fottner, J. (PI) & Zäh, M. (PI)
1/10/22 → 30/09/25

Ökett: Life Cycle Assessment for new adhesive labels
Fröhling, M. (PI) & Zäh, M. (PI)
1/11/21 → 31/01/22

ReNaRe: ReNaRe: H2 Giga: Recycling and Sustainable Resource Use - Circular Economy Concepts and Economic Feasibility
Fröhling, M. (PI)
1/04/21 → 30/09/25

RePurKo: RePurKo: Elaboration and assessment of new recycling concept for polyurethane composite wastes
Fröhling, M. (PI)
1/09/21 → 30/06/22

r+TeTra: r+TeTra: Technology Transfer Project – Sub-project 2: Impact Assessment in the BMBF funding scheme r+ Impulse: Innovative Technologies for Resource Efficiency
Fröhling, M. (PI)
1/01/16 → 30/06/23

TU&M: Timber Use and Maintain (TU&M): Development and assessment of circular woodframed building elements
Fröhling, M. (PI), Winter, S. (PI), Benz, J. P. (PI), Birk, S. (PI), Petzold, F. (PI) & van de Kuilen, J. W. (PI)
1/02/23 → 31/01/26