

CREST Report ior/cf-HSG

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Prof. Dr. Karl Frauendorfer (principal investigator within CREST) is head of the Institute for Operations Research and Computational Finance of the University of St. Gallen (ior/cf-HSG). In addition, the institutes' members Ass.-Prof. Robert Gutsche (PhD), Ass.-Prof. Dr. Thomas Walther, Dr. Gido Haarbrücker, Dr. Christian Opitz, Dr. Michael Schürle, and Claus Liebenberger are members of SCCER CREST. Within the first phase of CREST, Ass.-Prof. Dr. Michael Gratwohl and Prof. Dr. Florentina Paraschiv also contributed with their research activities.

Projects

Algorithmic Cross Border Intraday Trading

One key function of electricity intraday markets is the possibility of closing open positions due to changes in feed-in forecasts from renewable energies such as wind and photovoltaic. The difference to the latest (and most probable) forecasts to the ones upon, which were traded at the day-ahead auction must be closed in order to maintain the schedule of power production or demand reported to the grid operators. The European Cross-Border Intra-Day Trading (XBID) Platform was effectively launched June 12 for delivery June 13, 2018. Since its start, the trading system has been running stably and has shown continuous growth with up to 1.4 million monthly trades (October 2018). XBID couples the markets of 14 countries namely Austria, Belgium, Denmark, Estonia, Finland, France, Germany, Latvia, Lithuania, Norway, The Netherlands, Portugal, Spain, and Sweden. For summer 2019, a second go-live wave is planned, which will further integrate Eastern-European partners into XBID (Bulgaria, Croatia, Czech Republic, Hungary, Poland, Romania, and Slovenia). XBID is part of the European Union's plans to establish an EU-wide fully integrated electricity market. The platform allows for intraday trades when cross-country capacities are available and thus, implicitly trades those capacities together with the electricity. Depending on the individual operator's market area, the tradable products include 15-min, 30-min, hourly, and user defined blocks. Thus, from an operational point of view, monitoring all tradable products is not manageable continuously and effectively by single human traders. Moreover, the complexity in the intraday market increases due to specific contracts, which are tradable separately within certain delivery areas up to five minutes before delivery (only Germany). Furthermore, the intraday markets are highly volatile and do not provide constant liquidity. In this challenging setting, the utilization of automated trading algorithms may ensure a continuous, consistent, and cost effective manner of closing the changing open positions while assuring compliance with imposed risk management directives and trading guidelines. A trading algorithm needs to identify the current market situation, i.e. whether cross-border trading is active or only the local market is accessible, the current and forecasted weather etc. Given the order book, the algorithm automatically acts in the current available market environment. Hence, it may simply take given bid or ask orders, or, if it is more favorable, places own bid or ask orders. Given that each hour has up to seven standardized contracts (full-hour, two 30min, and four 15min) in addition to the customizable block contracts and different order types and restrictions (such as Iceberg orders), the complexity might be too high for human traders. However, a well-designed trading algorithm applies a given set of rules, which can be constrained in order to comply with internal and external risk management (e.g. RAROC approaches). Lastly, it is essential to measure the performance of such automatic trading routines given the stochastic nature of the feed-in by renewables energies.

Marketing of Hydro Storage Capacities in Asset-backed Trading without Access to XBID

Short-term Asset-backed trading covers the offer placements in the auctions of system services as well as trading in spot market. The spot market is decomposed into the day-ahead auction and the continuous-time trading in the intraday-market. As the market area Switzerland has not been integrated into the European Cross-Border Intra-Day Platform (XBID) launched in June 2018, Swiss power producers no longer have access to the liquidity of the coupled intraday market. This regime will hold as long as there is no agreement with the EU. Yet, the Swiss hydro storage capacities still offer important flexibilities for the market of system services. As the demand for Swiss reserve energy is capped at about 1 TWh, and the competition for system services steadily increases, we investigate proper means to protect the Swiss producers against further losses. This requires the design and valuation of new products for system services to compensate at least partially the missing opportunities due to no access to XBID. In addition to the current situation, market data cannot be used to replicate the production schedule of storage power plants (in particular hydro storage power plants). Thus, markets reveal a degree of incompleteness on the matter. A decision support system is developed, which considers this incompleteness in order to market hydro power capacities and covers risk management tasks in an integrated way.

Asset Backed vs. Proprietary Trading

Within the research and teaching, the ior/cf-HSG focuses on the discrimination between asset-backed trading and proprietary trading and work out trading cases, which reveal the difference in their risk exposures. Relying on market efficiency, we apply martingale pricing for teaching how to replicate imbedded options in high volatile markets. This is primarily done in discrete time, which allows for incorporating transaction costs in trading. In addition, we reveal the many opportunities for covering potential losses in proprietary trading with income in asset-backed trading and/or in the marketing of the physical delivery of flexible hydro plants.

Megatrends Analysis for Utilities

Since mid-2017, eleven Swiss municipal utilities, four industrial partners and three research partners - including the Competence Center Energy Management located at the Institute for Operations Research at the University of St.Gallen - have come together under the umbrella of "Swisspower Innovation" to further develop business models and products in a cross-company and cross-industry innovation platform. From January to September 2018, the Competence Center Energy Management (ior/cf-HSG) identified and evaluated the (mega-)trends relevant to the energy industry on the basis of an analysis of the relevant specialist literature and numerous in-depth

interviews with selected experts. The opportunities and risks for Swiss municipal utilities resulting from two workshops with Swisspower Innovation's practical partners were then outlined and possible future positioning options developed with the help of (ideal-typical) role models. As an output of the project, Swisspower Innovation published a joint brochure in January 2019, which is intended to provide the strategic and political management level of Swiss municipal utilities with methodological and content support in the strategy development process - above all in strategic environmental analysis and corporate positioning based on normative criteria. For the year 2019, two energy suppliers - StWZ Energie AG, based in Zofingen, and Energie Thun AG - have already announced a revision of their strategy on this basis and have requested methodological input from the Competence Center Energy Management (ior/cf-HSG) for management and the Board of Directors respectively.

Development of a municipal waste management concept for the city of Zurich

Megatrends such as, for example, the growing need for more convenience, increasing possibilities for digital incentives for the urban population and the fundamental change in the Swiss waste industry towards a circular-flow economy triggered by the VVEA (Ordinance on the Avoidance and Disposal of Waste), which came into force in 2016, make it necessary to continuously review the existing disposal and recycling concept for municipal waste in the City of Zurich. The Competence Center Energy Management (ior/cf-HSG) was asked to evaluate and, if necessary, further develop the existing municipal waste concept in cooperation with Entsorgung + Recycling Zürich (ERZ) between March and October 2019. In this context, the (mega-)trends in the field of Swiss municipal solid waste, good practices of disposal/recycling concepts on a national and international level as well as the central needs of the urban population of Zurich are to be included. The aim of the project is to answer the questions of how much (volume) and what (composition) municipal waste will accumulate in the future on the territory of the city of Zurich and who will then dispose of this waste when (time), in which manner (system design/disposal infrastructure) and at what cost (financing). This requires a careful balance between sustainability, comfort issues and financial viability, which presupposes the development of an overarching normative framework in the sense of a "circular-flow economy vision".

Publications / Working Paper / Work in Progress

- Daniela Escobar, Florentina Paraschiv, Michael Schürle (2019). Recovering distortion functions in power markets under model ambiguity. (title tentative)
- Duesterhoeft, M.; Schiemann, F.; Walther, T. (2019): Practices of Risk-Disclosure: An Empirical Analysis of European Energy Utilities (Work in Progress)
- Aust, B.; Horsch, A.; Klein, T.; Walther, T.; Ziel, F. (2019): Coping with Negative Electricity Prices. (Work in Progress)
- Swisspower (Ed.) (2019): Stadtwerk 2025. Strategische Positionierung in Zeiten des Wandels. Unter Mitarbeit von Christian Opitz, Tiffany Germann, Orlando Gehrig, Luise Letzner und Manuel Berkel. Bern.
- Frauendorfer, K.; Gutsche, R. (2019): Die Rolle des Stromhandels in der Schweizer Stromwirtschaft (White Paper), [\[Link\]](#)
- Frauendorfer, K.; Gutsche, R. (2018): Das Accounting Puzzle der Schweizer Stromwirtschaft (White Paper), [\[Link\]](#)
- Frauendorfer, K.; Paraschiv, F.; Schürle, M. (2018): Cross-Border Effects on Swiss Electricity Prices in the Light of the Energy Transition. *Energies* 2018, 11, 2188. Open Access. [\[Link\]](#)
- Opitz, Christian (2018): Megatrends der Energiewirtschaft von morgen. In: Ronny Kaufmann und Stefan Rechsteiner (Eds.): Governance der Energiewende. Verantwortung und Führung in öffentlichen Unternehmen. Bern, pp. 195-205.
- Opitz, Christian (2018): (Mega-)Trends/Stadtwerk 2025. Abschlussbericht. St.Gallen.
- Charfeddine, L.; Klein, T.; Walther, T. (2018): Oil Price Changes and U.S. Real GDP Growth: Is this Time Different?. Working Paper. [\[Link\]](#)
- Nguyen, D.K.; Walther, T. (2018): Modeling and Forecasting Commodity Market Volatility with Long-term Economic and Financial Drivers. Working Paper. [\[Link\]](#)
- Frauendorfer, K.; Schürle, M. (2017): Das Erlöspotential der Schweizer Grosswasserkraft, Technische Dokumentation und Studie im Auftrag der Regierungskonferenz der Gebirgskantone. [\[Link\]](#)
- SCCER CREST White Paper Nr. 1: Wasserkraft: Wiederherstellung der Wettbewerbsfähigkeit. [\[Link\]](#)
- SCCER CREST White Paper Nr. 5: Strommarktdesign: In welche Richtung soll es gehen?. [\[Link\]](#)
- Paraschiv, F.; Schürle M., Frauendorfer K. (2016): Econometric analysis of the determinants of electricity wholesale prices in Switzerland and Germany, Final Report, Project Energy-Economy-Society. [\[Link\]](#)