

Energy System Planning

- Examples, general approach and aspects related to other industrial OR applications -

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Linear and MIP Optimization models are used for energy system planning for more than 40 years. Initially used for large scale models of regions, countries, large utilities and energy intensive industry, similar methods are applied today for energy management and energy optimization of smaller systems, e.g. industrial energy management and energy optimization of facilities. Increasing power generation from fluctuating renewables and fast changing regulation and market conditions cause high uncertainties. Decisions based on uncomplete information require advanced methods for short, medium and long term planning for infrastructure provider and market participants. Industrial companies have to meet increasing energy management requirements.

Three project examples will present a general approach for energy system planning and specific aspects related with practical optimization problems in other application fields.

How to deal with large and complex energy systems, uncertainties, uncomplete data and nonlinear dependencies? Challenging projects like the set up of a power system master plan for Afghanistan will force a kind of puzzling competition. Key elements include preliminary analysis, model simplification, core model optimization and an extensive validation process. Several iterations may use different point of views and different models of the original decision problem. Uncomplete data and high uncertainties are part of the original decision problem and imply multi-stage decision processes for candidate projects. Additional model constraints for the timeline of these candidate projects ensure robust strategies.

Current and future changes of the power market on the one hand and fast integrating IT and automation technologies on the other hand enable new energy and measurement based services for specific infrastructure provider of airports, ports and industrial sites. The SmartEnergyHub research project adresses these opportunities and will use an optimization modul to explore new specific energy and measurement based services. Apart from application fields and market segments cost-benefit analysis is used to define size, details and complexity of underlying optimization models.

How to optimize energy systems having a high share of fluctuating renewables? A small project example illustrates stochastic input data, dependencies and some practical restrictions. Even small and simple optimization model will show important aspects. Very large and complex optimization models are more suitable, but may include some additional minor errors and some people may not be able to explain some impressing results to an astonished audience.