

Exploration of near-optimal solutions in energy system optimization models

Semester project / Master thesis proposal

Sometimes the optimum is not enough... Energy system optimization models, commonly expressed as cost minimization problems, typically return a single optimal solution per set of input parameters. Nevertheless, in many cases, solutions that are close to the optimal and achieve only slightly worse performance may also correspond to competitive, alternative options (see Figure 1). For instance, they might correspond to energy system designs with unmodeled advantages, such as higher feasibility for real-world implementation. As a result, exploring the near-optimal decision space can offer further insights that better inform decision-making.

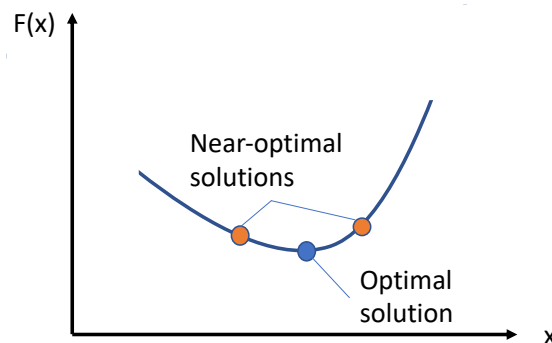


Figure 1. Illustration of the relationship between optimal and near-optimal solutions

Since the 1970s, multiple methods have been developed to generate near-optimal solutions for energy and other optimization problems. However, we do not fully understand how the different methods compare to each other and what their relative advantages and disadvantages are. Therefore, this project's aims are:

- (i) to review the approaches from the literature that have been developed to explore the near-optimal solution space,
- (ii) to implement the most prominent ones into an existing energy system optimization model (will be provided and will not have to be developed in this project),
- (iii) to compare their performance in terms of the quality of near-optimal solutions that they generate.

Skills required: Scripting programming language (preferably Python or Matlab)

Skills desired: Experience with energy system modelling and optimization

The student will be embedded within the highly interdisciplinary SusTec team and will be supervised by **Dr. Georgios Mavromatidis** (gmavroma@ethz.ch). To apply please send a recent version of your CV, a short statement outlining your motivation for the project, and your transcript of records.