Homework 2

May 23, 2023

Please provide short answers! Bullet points are also accepted as answer. You can submit one julia file which contains all the tasks, as well as only one set of csv files containing all the tasks.

Hand in until Monday, June 05 (16:00)

Changes to lecture version:

- Increased demand values by 120 and removed the 1/120 factor from production constraint.
- Changed MaxPotential for PV and Wind Onshore
- Changed Emission Limit
- Fixed a bug where the capacity factor for solar pv was 1 during night hours

Task 1: Pumped Hydro Storage

Add another storage to the model, according to the specifications below.

- The name should be PHS
- The $InvestmentCostStorage$ are 0, the E2P ratio is 120
- The charge efficiency is 0.9, the discharge efficiency is 0.85 for power

The *investmentcost* are 0 since we assume that already existing facilities can be used. However, you need to introduce a constraint which limits the maximum amount of storage capacity. The Parameter $MaxStorageCapacity_s$ is already read in, you only need to write a constraint limiting the sum over all fuels of $StorageEnergyCapacity$ by the $MaxStorageCapacity$.

Describe what the effects on the overall results are. Is there a change in production/storage? If yes, where?

Your objective value should be 7208.87 (rounded)

Task 2: Storage losses

Energy is not only lost in the process of charging or discharging a storage but also over time while stored. Implement the functionality to account for storage losses.

You will need a new parameter "$StorageLosses$" which you need to create a .csv file for. This parameter describes how much percent of the energy content of a storage in an hour h is transferred to the hour $h+1$. Assign the values 0.999 for $Battery$ and 0.99 to PHS. Implement the functionality in the model, think about in which constraint(s) this parameter needs to be inserted. You will also have to change your $StorageAnnualBalanceFunction$ to the following way:

$$StorageLevel_{s,n\_hour,f} = 0.5 * StorageEnergyCapacity_{s,f}$$

What is the effect on the overall model results? Describe briefly.

Your objective value should be 7264.6 (rounded)

Task 3: Hydrogen storage

Until now, hydrogen had a steady demand and no option for storage, meaning that hydrogen had to be produced always on demand. We want to include the option now of storing hydrogen to make use of times of surplus energy. Therefore, add another storage $H2Tank$ with the following parameters.

- The name should be $H2Tank$
- The InvestmentCostStorage are 0.1, the E2P ratio is 4
- The charge efficiency is 0.95, the discharge efficiency is 0.95 for $H2$
- The losses are 1, meaning no hydrogen is lost at all.

What is the effect on the overall model results? Describe briefly.

Your objective value should be 7111.479 (rounded)