Feasibility study to develop an action plan counteracting increasing electricity prices

Introduction

In recent years there has beeen a rapid growth of electricity generation based on renewable energy sources (RES). In particular, electricity generation by solar and wind power plants showed an impressive development. During the last three decades their annual growth rate was about 15 % on average while other renewable energy sources showed less than three percent, which corresponds to the annual growth rate of non-renewables (Enerdata, 2023).

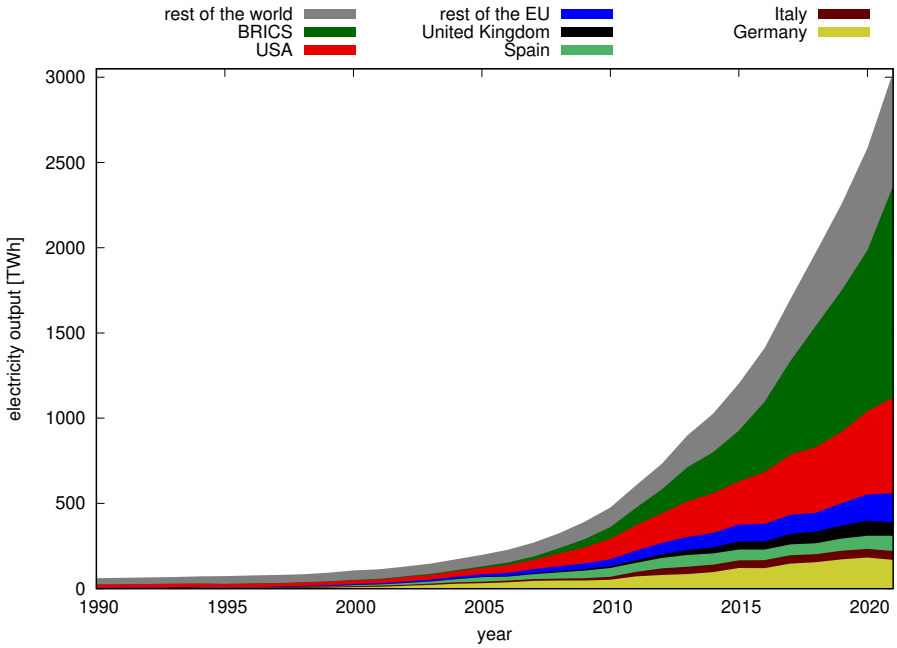

Figure 1: Stacked area chart illustrating the development of electricity generation based on wind and solar power plants in selected countries and worldwide from 1990 until 2021; own illustration based on data provided by Enerdata (2023), Working Group on Energy Balances (2018).

While this impressive development was based on massive subsidy payments in the past, electricity from wind and solar power plants is becoming more and more competetive. The concept of so-called levelized cost of electricity (LCOE) tries to measure

and compare the cost of different technologies for electricity generation. In fact, solar and wind power plants at good sites in Germany have lower LCOE than conventional fossil power plants (see Fig. 2). This development also attracts attention of electricity consumers. This particularly applies to companies with a comparatively high electricity consumption.

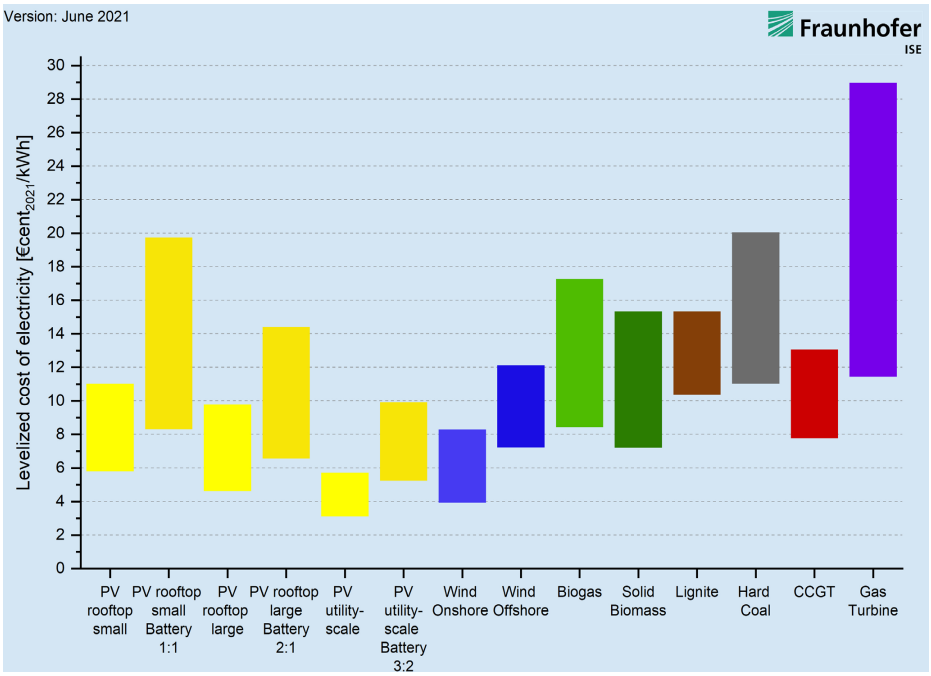

Figure 2: Levelized cost of electricity of renewable energy technologies and conventional power plants at different locations in Germany in 2021. The value under the technology refers in the case of PV to the global horizontal irradiance (GHI) in kWh/(m^2 a), for the other technologies to the annual full load hours (FLH). Specific investments are taken into account with a minimum and maximum value for each technology; source: (Kost *et al.*, 2021).

Your client

Your client is the Stahl GmbH located in North Rhine-Westphalia, Germany. The company produces steel rollers for export and domestic demand. The electricity price is a crucial part of the company's cost since its annual electricity demand is about 3.4 GWh. Unfortunately, the new contract for electricity asks for 0.08 €/kWh which eventually endangers the business model of the company.

The Stahl GmbH is the proud owner of a field with an area of ca. 6 hectares in a distance of roughly 1 km to the company. According to the company's considerations this field could help to solve the electricity price problem because it shows enough space to build a solar power plant with a nominal output of 7.8 MWp. However, the company's grid connection point is limited to 2 MW.

Your project

Your task is to write a feasibility study in which you advise the company how to reduce its electricity cost. Moreover, you need to convince your client of your concept in a presentation. So far you already have the following information:

- The Stahl GmbH provided you with its load profile of several years (15 minutes basis)
- You have two electricity yield reports for two different configurations of the possible power plant
- You know that LCOE for a solar power plant with nominal output equal to 780 kWp is 0.07 €/kWh while it will be 0.06 €/kWh for 7.8 MWp (linear interpolation for intermediate values).
- A lithium-ion battery of capacity (and nominal power) equal to the solar power plant will increase LCOE by roughly one third. For instance, a battery with 780 kW nominal power increases LCOE from 0.07 € to 0.0933 €/kWh. A smaller storage leads to a proportionally reduced price.
- For excess electricity injected to the public grid you only receive 0.073 €/kWh.

What your client expects you to deliver:

- You need to provide the work breakdown structure (WBS), a project schedule and a Gantt Chart with critical path.
- An outline of your project you have to deliver until **June 6, 2023** (upload in campUAS until 12 pm).
- You have to gather **relevant** and **project-related** information about storage facilities and other technical components where necessary (A feasibility report is not collection generally available information).
- You should make some scenario calculations with different configurations of the power plant. However, think about what you want to find out, how you will do it and how long it will take before you start calculating – make a project plan!
- On **June 27, 2023 at 2:30 pm** you should present your intermediate results and point out what else you will do and how long it will take (plan your project; upload your presentation in campUAS until 12 pm on **June 26, 2023**).

- Deadline for submission of your final report is **July 25, 2023**. The report (15-20 pages, written in English) should be uploaded to campUAS until 12 pm and include

→ an executive Summary,

→ an explanation and results of the feasibility study,

→ a time plan with Gantt chart for further action

→ and conclusions and recommendations

- On **July 25, 2023 at 2:30 pm** you should present your results in the final presentation.

I wish you good luck with your project!

References

Enerdata (2023). Global energy statistical yearbook. Available at: `https://yearbook.enerdata.net/`, accessed May 29, 2023.

Kost, C., Shammugam, S., Fluri, V., Peper, D., Nemar, A. D. and Schlegel, T. (2021). Levelized cost of electricity: Renewable energy technologies. Available at: `file:///C:/Users/Sch%C3%A4fer/Downloads/EN2021_Fraunhofer-ISE_LCOE_Renewable_Energy_Technologies-1.pdf`, accessed November 13, 2022.

Working Group on Energy Balances (Arbeitsgemeinschaft Energiebilanzen e.V) (2018). Bruttostromerzeugung in Deutschland ab 1990 nach Energieträgern. Available at: `https://ag-energiebilanzen.de/index.php?article_id=29&fileName=20171221_brd_stromerzeugung1990-2017.xlsx`, accessed September 4, 2018.