Waste Challenge Title

Creating the universities of tomorrow by optimizing lectures with regards to their energy efficiency.

Introduction:

The beginning of the COVID-19 pandemic has rocked the universities across the world with presence lectures no longer being possible and online lectures becoming daily routine. Even though education in presence has been now reestablished in several universities, the experience and know-how gathered over the past years about online teaching cannot be ignored. As the biggest difference between presence and online lecture, transport has a significant impact on the energy consumption of lectures. Through optimization of lecture schedules and a mix of online and on-site lectures, universities could potentially reduce their energy footprint. We already have developed a simple calculator tool, our elecCalc, which allows lecturers and students to calculate the energy consumption of individual lectures. Using this toolkit as a base, we want to expand on this idea and create a tool which is easy and convenient to use, but also sophisticated under the hood. Eventually, this calculator could then be routinely integrated in the planning and scheduling of lectures.

Problem Definition:

Have you ever wondered whether it takes more energy to listen to online lectures or go to university? And how transportation, lecture halls, and video streaming contribute to the energy consumption of your lectures? Well, we have already developed a basic tool that helps you answer these questions! However, we still have a task for you: for our tool to be used TUM-wide in the planning of lectures with the minimum energy consumption possible, we need you to be creative in further developing it! Do you already know how to start?!

What is the waste challenge?

By challenging the participants to expand our elecCalc and create a tool that can be used to plan energy-efficient schedules, we are challenging them to understand and help others understand the impact of daily activities on our energy consumption. Through our challenge, all stakeholders can understand the impact of transportation on the energy consumption of lectures and acknowledge the opportunities given by digitalization. Having built this understanding and acknowledgment, both the challenge participants and the future users of the expanded elecCalc can efficiently shape their daily lives to avoid wasting energy, for instance through unnecessary commuting.

Key questions:

- *How can the students' schedules be optimized with the help of known energy consumption of individual lectures?*
- *Can the energy consumption of lectures be minimized by creating hybrid lectures where the splitting is based on travel distance?*
- *What are key infrastructure components, through which the universities themselves can significantly save energy?*
- *What is the minimum amount of information such a calculator needs to produce sensible results?*
- *How can you create a tool that is suitable for different universities?*

Who is behind this challenge?

This challenge is being placed by "us", Alexander Holas and Catherine Y. Koch, who represent the TUM:Junge Akademie Team "elecTUM". During our 20-month scholarship, together with six other students, we developed a project that was focused on assessing the energy consumption of university lectures and that delivered the tool elecCalc as its main result. Now that our scholarship has come to an end, we would like to allow other students to broaden the elecCalc with the aim to construct a tool that can be sustainably used by TUM and maybe even other universities!

Topic domain of challenge: Cities, Energy or Consumption

Energy

Desired Impact of Challenge:

Both lecturers and students alike have told us constantly that they would be very interested in knowing about the energy consumption of lectures, yet there is no tool available to easily gain access to this information. With our elecCalc, we intend to change this. While actively changing people's behavior towards conserving energy might be a rather ambitious goal, raising awareness about issues is an important first step in this endeavor. By offering an easy-to-use, yet powerful toolkit, we intend to follow this initial step with the aim to change the way university lectures are planned and held towards a less energy-intensive scenario.

Skills needed/recommended:

The project offers opportunities for almost everyone to contribute in some way, but some of the skills listed down below should be covered by at least some members of the group. If you think you're not proficient enough in any of these skills, don't worry. This project is a great opportunity to expand your skillset and learn new things!

- *Python programming (data analysis, Django framework, …)*
- *CI/ CD (GitHub Workflows)*
- *Web-design / -development*
- *Graphic-design*
- *Marketing & communication*

Remember that these skills represent our vision for the project. If you want to take it in another direction, other skills might come in handy!

Relevant considerations for the challenge / theme:

- *The energy consumption of a lecture is very complex and influenced by several aspects. It is important to find a middle ground between a model simple enough so that the relevant data can be gathered easily and a model complex enough to not miss important details. You will need to make assumptions, but be careful to not oversimplify the model.*
- *Developing a calculator toolkit requires work on many fronts: The core calculator needs to be programmed with the appropriate model, taking care of as many edge-cases as possible. A pleasant and comfortable interface has to be created, such that the usage of the calculator is intuitive to use. Documentation has to be written. The list goes on. As a consequence, resources have to be allocated accordingly and you will need to make compromises to cover all tasks.*
- *What works for one university, might not work for another university. Make sure that the calculator is not designed to work only with one specific university in mind.*

- *The current elecCalc is published under a GPLv2 license, meaning that anyone can contribute to it. But this also means that, if you want to use it as a base, it must not result in a proprietary calculator tool. Also think about modularity and expandability so that, in the future, it is easy to add more functionality to it.*
- *The participants must agree with having the outcome of the challenge further expanded, for instance through other hackthons. Further, the participants must agree with making the outcome accessible to other TUM organizations, so that, in the best scenario, the final product can be adopted by a TUM organization and continuously used in favor of the whole TUM community and other universities.*

Relevant links:

- *Current publicly available version of the elecCalc toolkit: https://electum.ja.tum.de*
- *GitHub repository: https://github.com/AlexHls/ElecCalc*
- *Paper published on the work conducted by elecTUM: https://iopscience.iop.org/article/10.1088/2515-7620/ac77df ("On the energy consumption of online and on-site lectures")*
- *Research report on the work conducted by elecTUM: https://drive.google.com/file/d/14vyNwjn3rZHB1TMWKyErC7MYkaUFyONm/view?usp=sharing*
- *Scientific & technical implementation: Alexander Holas (alexander.holas@tum.de)*
- *Data collection & communication: Catherine Yngaunis Koch (catherine.koch@tum.de)*