STUDENTS ORGANISING FOR SUSTAINABILITY UNITED KINGDOM

Interreg North-West Europe RED WoLF European Regional Development Fund

RED WOLF STUDENT CHALLENGE 2021: CHALLENGE ABSTRACTS

During the RED WoLF summer school, students will work in small interdisciplinary groups to address one of the challenges below related to the RED WoLF project. Students will be able to pick their first and second preference for challenge, based on academic experience and interest.

Please read the seven challenge abstracts below, and fill in your preference here: https://forms.office.com/r/Et3rkTu92j

Challenge 1: Economics of the RED WoLF system: accounting for environmental costs and benefits

The cost of systems like RED WoLF is around three times that of providing a space and water heating system based on oil or fossil fuel. Furthermore, systems like RED WoLF might not provide any savings to residents' utility bills compared to modern oil or gas central heating systems and could even be more expensive to the consumer.

Without subsidies or grant funding, there are currently few, or no, apparent financial benefits either for the housing provider or for the resident in changing to this type of system. However, systems like RED WoLF offer solutions to long-term climate change mitigation. Students working on this challenge will be addressing the below questions:

1. How do we factor in environmental considerations to cost-benefit analyses, to ensure systems like this are viable?
2. What financial role can/should housing providers, residents and other stakeholders play?
3. What role can key stakeholders play in changing the status-quo of carbon-intensive energy systems being more economically viable than energy systems that will help in addressing the climate crisis?

Challenge setter: Jose, Carbery housing
Best suited for: Students from any discipline, but will be particularly relevant for those studying Economics and related subjects.

Challenge 2: Engaging residents with home energy issues

How engaged are residents with their home energy, and what are the barriers to residents, and the wider public, becoming more engaged and informed energy consumers? This challenge will explore resident experience and engagement with issues relating to their home energy (including energy suppliers, energy tariffs, smart technologies, and sustainable energy use within the home), with recommendations generated for improved engagement.

You will also work specifically exploring resident engagement with RED WoLF technologies in the pilot sites, including creating a questionnaire for the pilot sites, analysing responses and reporting on findings.

Challenge setter: Rachel, SOS-UK
Best suited for: Students from any discipline.

Challenge 3: Energy poverty and social inclusion with the RED WoLF system

Currently many of the RED WoLF pilot sites are in Local Authority or Housing Association homes, but if the RED WoLF 'product/solution' is to become a commercial offering, private homeowners will have a distinct advantage over those in rental accommodation, who may also be vulnerable to energy poverty. Those who can afford to install Solar PV, storage systems etc. have an obvious advantage in that they are in a position to gain from their already privileged position. It is important to address the negative distributional effects where those who cannot afford or who are unable to participate are, in effect, subsidising those who can.

How do we ensure electricity consumers and landlords/owners of rental accommodation pay equitably towards the costs of transitioning towards cleaner, smarter electricity grids and ensuring it is a Just Transition?

Challenge setter: Stevie, ITS
Best suited for: Students from any discipline, but may be of particular interest to those from sociology and social policy backgrounds.

Challenge 4: Communicating low-carbon energy transition solutions

In order to secure future widespread adoption of technologies like RED WoLF, we need to have a strong business plan and communications plan. Students working on this challenge will develop these plans (including stakeholder mapping) for promoting the RED WoLF technology as a solution for a low-carbon energy transition, with a particular focus on local authorities, housing associations and education institutions (who could use the RED WoLF system on their campuses/estates).

Challenge setter: Rachel, SOS-UK

Best suited for: Students from any discipline, but will be particularly relevant for those studying Business, Marketing or related subjects.

Challenge 5: Benchmarking analysis of the RED WoLF Hybrid Storage System

When proposing a new solution, as the charging/discharging optimization strategy proposed in RED WoLF (using a progressive threshold approach), it is important to benchmark the proposed strategy against state-of-the-art approaches and/or a reference scenario. In this challenge students will compare different scenarios to show the extent to which a RED WoLF-like strategy allows for improving today's energy systems. These scenarios are the following:

- Scenario 1: students develop a basic algorithm that assesses the financial cost and amount of Co2 (based on grid carbon intensity signals) that a system without any PV and battery system would result in;
- Scenario 2: students add a PV array to the house and must propose/develop a second algorithm that assesses the financial cost and amount of Co2 that results from that infrastructure;
- Scenario 3: students add a battery to the Step 2's infrastructure (battery being charged without any optimization algorithm) and must propose/develop a third algorithm that assesses the financial cost and amount of Co2 that results from that infrastructure;
- Scenario (slide denoted by Step 4): students add an optimization layer to optimize when to charge/discharge the battery depending on the house demand forecasts, PV forecasts, carbon intensity forecasts (could be the algorithm proposed in RED WoLF, or any new/innovative idea that students could come with).

Challenge setter: Paul, Eric, Sylvain, UoL

Challenge 6: RED WoLF Algorithm

The energy consumption of a household is not evenly distributed. Furthermore, the statistics show that peak consumptions occur at time where photovoltaic power generation is at lowest or non-existent. Moreover, the peak power consumption is associated with on-demand fossil fuels power generators, which in comparison to renewable and sustainable power plants can be switched on and off whenever is needed. As a result, every unit of energy becomes more carbon intense in these periods of time. Fortunately, there is a way out. One of such possibilities is to store "green" and less carbon intensive energy in order to release it at the moment of the consumption demand. In this challenge we would expand the idea progressive threshold approach of the RED WoLF control algorithm described in (https://doi.org/10.1016/j.apenergy.2020.115209). This would allow us to study how addition of various storage reservoirs can affect the performance of the Hybrid Storage System.

Challenge setter: Sasha, LBU
Best suited for: Students with some knowledge of calculus and MATLAB or python programming languages.

Challenge 7: From weather predictions to RED WoLF Hybrid Storage System Performance

Since the work of Edward Lorenz six decades ago, Weather is considered a chaotic system and therefore with a limited predictability horizon. Weather does influence home energy usage mainly through external temperature and the ensuing space heating and AC demand. With the increasing penetration of solar and wind generation, weather impact on the energy system is becoming increasingly important also on the generation side. The challenge for students is to start from the consumption timeseries of a state or country and come up with a set of entirely renewable energy mixes (comprising only solar and wind) split into a predictable part given by climatology ad a fluctuating part. Storage should be used to both smooth out fluctuations and to offset the time mismatch between demand and the predictable part of renewable generation.

Challenge setter: Giuseppe, LBU
Best suited for: Students from maths or physical science backgrounds, as well as students from engineering backgrounds with theoretical and/or environmental interests.