Coding Challenge...

AIMLAC Coding Challenge 2021 – Request for Proposals

You are invited to submit a proposal for a software solution to manage renewable energy systems for the new offices of the Centre for Doctoral Training in Artificial Intelligence, Machine Learning and Advanced Computing.

The location

The offices are to be located 2.5km west of Llanwrtyd Wells railway station in Mid Wales at coordinates 52.1051, -3.6680. This is approximately the central point of the five partner universities which make up the CDT. The location is approximately 470 metres above sea level and 220 metres above Llanwrtyd Wells in a former forestry site on top of a mountain.

Location:
(52.1051, -3.6680)
2.5km west of Llanwertyd Well train station
470m above sea level
220m above Llanwertyd Wells

Electrical systems

The building is 50m x 50m with shared and individual office space for up to 90 people. A solar panel array consisting of 1400 LG 335 W Mono Neon2 A5 panels is located on south facing 45 degree sloped brackets on the roof. These provide a combined output of up to 470 kW in ideal conditions. Two Endurance E3120 50 kW wind turbines are located a few hundred metres from the main building at 52.1030, -3.6690 and 52.1040, -3.6685.

Solar Panels:
Building footprint: 50m x 50m
1400x LG 335W Mono Neon2 A5 panels
South facing
45 degree angle to roof
470kW output (combined) in ideal conditions

Wind Turbines:
2x Endurance E3120 50kW
(52.1030, -3.6690)
(52.1040, -3.6685)

The building is electrically heated with a system using up to 120 kW. On site data centre equipment and computers use up to 200 kW, personal computers and office equipment a further 10 kW and lighting and other equipment up to 20 kW. The building will typically only be occupied between 9am and 5:30pm Monday to Friday and not during bank holidays.

Building Energy Use:

Heating:	Up to 120kW
Data Centre:	Up to 200kW
Office Equipment:	10kW
Lighting etc:	Up to 20kW
Occupied:	Mon-Fri 09:00 - 17:30 (Closed bank holidays)

The site is connected to the national grid through a cable capable of carrying 50 amps/11,000 volts (550 kW). The on site generation equipment is able to both supply the site and export electricity. Excess power which cannot be exported is lost by disconnecting the solar array or wind turbine. Note that it is only possible to disconnect the entire solar array, a single wind turbine or both wind turbines. Individual solar panels cannot be disconnected. There is currently no energy storage on site.

Grid Connection:
50A / 11,000V (550kW)
Excess power lost by disconnecting Panels / Turbine(s)
Whole solar array disconnected but one or both turbines can be
No energy storage on site

Your Task

- Predict on site power generation at 30 minute intervals for at least the next 24 hours. The National Grid charges a penalty fee for any power generator who over estimates their power output and is unable to deliver.
- Automatically decide upon a price to sell any excess electricity to the National Grid. The price must be as profitable as possible while still being competitive with the general wholesale market. This must be specified at 30 minute intervals.
- Produce a regular report for management stating:
  - Revenue from selling electricity
  - Cost of imported electricity
  - Cost savings compared to buying from the National Grid at a rate of 15 pence per kilowatt hour.
  - Carbon dioxide savings compared to buying from the National Grid. Note that the carbon intensity of the grid varies.

Task:
- Predict on site power generation at 30m intervals for next 24hr
- Calculate price to sell excess power to grid (profitable but competitive) also in 30m intervals

Expected sunlight on panels (pre weather, ie time of day, time of year)
Cloud cover / weather on day - fraction of expected sunlight that gets to panels?
Solar panel response to sunlight
Expected wind speed at turbines (does direction matter?)
Wind turbine response to wind speed

How much excess power do we have to sell to grid?:
- Building energy use changes over year
- Only occupied Mon-Fri 09:00 - 17:30

How much do others sell to grid for?
Need margin to cover times when we do not generate enough energy and need to buy from grid
Grid connection capacity
Do not over-estimate amount to sell

Report:
- Revenue from selling power
- Cost of imported (when not generating excess)
- Savings compared to buying at 15p/kWh
- CO2 saving compared to grid

Your Proposal

Deadline: 5pm on Friday February 26th 2021
Submit proposals to: coding-challenge@cdt-aimlac.org

State a summary of your proposed solution on no more than two pages of A4.

Proposed implementation

Describe or explain how your solution will:

- Predict the output of the solar panels and wind turbines
- Predict demand for the office building itself
- Decide upon your bid price
- Mitigate the risk of your model making incorrect predictions

Team description

- Who is going to deliver this project. Include a brief description of each member's expertise.
- Describe what each team member will contribute to the project.

Costings

- State the full economic cost of your proposal by:
  - Assigning a pay grade and spine point for each team member and working out how many hours they will contribute. We will only consider staffing costs up to spine point 43. Cheaper proposals will be preferred.
  - Use your university's full economic costing spreadsheet to calculate the cost of each team member.
  - Note this is a student project, you won't really get paid this money.

You will be informed if your proposal has been accepted along with any reviewer comments by 5pm on March 5th 2021. Accepted proposals will be required to present their ideas via video conference on the week commencing March 8th. You will have until June 2021 to produce a working solution. Multiple proposals will be accepted.