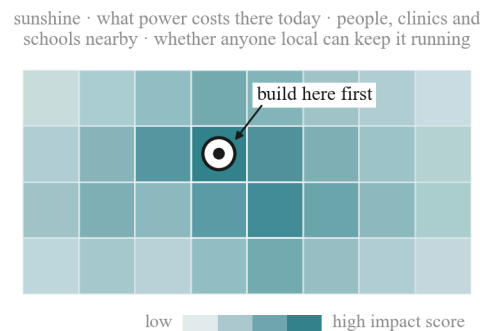
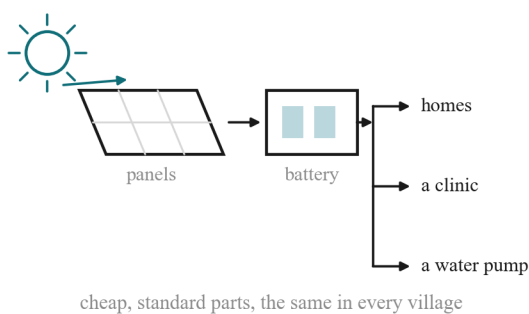


Africa Solar Micro-Grid Project

Intuitive Understanding

Panels, inverters and batteries are now cheap catalogue products, so building a small solar grid for one village is no longer the hard part. Choosing the village, and the load being powered is. Two places with the same sunshine can be worth very different amounts once you account for what power costs there today, how many people there are, whether a clinic or a school is nearby, and whether anyone local can keep the system running.



The final presentation will be held in the House of Lords, where the team will present to the heads of several foundations with the aim of securing funding for their concept.



The House of Lords

Project Scope

Over 600 million people across Sub-Saharan Africa still lack reliable access to electricity, and conventional grid extension remains prohibitively expensive or slow to reach much of this

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population. Commercially available solar panels and battery energy storage systems (BESS) are now cheap and modular enough that hardware is no longer the binding constraint – the challenge is knowing exactly where to deploy a micro-grid, and how to size it, to deliver the greatest benefit.

The aim is to Design a Commercially Buildable Solar Micro-Grid System and a Multi-Factor Geographic Impact Model that identifies the specific locations across the target region where that system would deliver the greatest benefit – output as an overlaid map of “Impact Score” per location. This is a team project rather than a competition: one team, split into two closely linked sub-teams for the two tasks below, works to optimise a single design and the choice of where to build it.

The following sections will break down the requirements and expectations of each task. However, it is important to remember that although these are outlined as separate tasks, they have significant reliance on information from each other – the geographic scoring model in Subtask 2 is only as good as the system-level cost and performance assumptions produced in Subtask 1.

Subtask 1 – Micro-Grid System Design and Battery Energy Storage Sizing

1.1.1 This task is to develop a concept design for a stand-alone (or weak-grid-connected) solar micro-grid built entirely from commercially available components – solar PV panels, inverters, charge controllers, and battery energy storage systems (BESS). The team should select specific, currently-available part numbers (with datasheets) rather than generic assumptions, so that costs and performance figures are grounded in real hardware.

1.1.2 The team must characterise a representative electrical load for the communities being targeted (e.g. household lighting and appliances, communal water pumping, a health clinic’s refrigeration and equipment, small commercial use) and use this to drive the sizing of the system.

1.1.3 A core deliverable is the optimal sizing of the BESS against the characteristics of this load – balancing depth of discharge, cycle life, and cost against the load’s peak demand, duration, and daily/seasonal variability. The team should justify why their chosen battery chemistry and capacity is the right trade-off, not simply the largest available.

1.1.4 The main task will require development of a techno-economic model of the whole system – generation (PV output as a function of solar irradiance), storage (BESS state of charge over time), and load – capable of simulating at least one full year of operation at hourly (or better) resolution. This can be created in a tool/language of the team’s choosing

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(Python/MATLAB/etc). This will be developed in stages: an initial model suitable for the first-phase presentation, and a higher-fidelity version for the final presentation.

1.1.5 Electricity price should be incorporated explicitly – both the price (or cost-of-service) the micro-grid can realistically charge or offset locally, and the capital and operating cost of the system – so that the model produces a genuine cost-per-kWh-delivered and a payback/return figure, not just a technical feasibility result.

1.1.6 The team should assess system reliability under realistic solar resource variability (cloudy periods, seasonal changes in irradiance) and specify what loss-of-load probability their design targets.

1.1.7 All designs should consider safety and practicality at the forefront – a system that is technically optimal on paper but cannot realistically be installed, maintained, or financed in the target region is not a good design. Justification of maintainability (spare parts, local technical skill, expected component lifetime) is required.

1.1.8 We would like to see evidence of verification of the model's outputs against published data (e.g. real micro-grid case studies, manufacturer performance data, or published solar resource datasets).

1.1.9 The primary figure of merit is realistic, deployable impact per unit cost. However, there is also significant weighting on other things such as:

- a) Modelling approach taken – the thoroughness, quality, and compliance with good coding practice such as PEP8.
- b) Project management and process – planning, recording of information, communication, risk capture etc.
- c) The consideration and justification of the level of modelling fidelity used. What assumptions have been used and how have they been captured? This is a powerful skill.
- d) Key points of learning during the task and how this is recorded. We want to see what you discover, how you explore options, what you learnt and how you then applied this.
- e) Novelty of the system design or sizing methodology.
- f) First phase presentation.
- g) Final presentation and summary report.
- h) Cross-functionality working and integration between the two sub-teams.

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- i) Depth of research.
- j) Realism of the underlying cost, component, and load assumptions.

1.1.10 The scope outlined isn't expected to be completed by the first deadline – this is for the final presentation. Progress up to the first phase is what the January progress review will look at. Students should utilise their relevant skills and interests to complete tasks they think will be useful and interesting, even if not explicitly listed here.

Subtask 2 – Multi-Factor Geographic Impact Scoring and Mapping

2.1.1 Not every location that lacks grid access is equally well suited to a solar micro-grid. This task explores where, geographically, the system designed in Subtask 1 would deliver the greatest benefit. The team should design and build a multi-factor “Impact Score” that combines system economics with geographic and social data to identify priority locations. See for example how organisations such as the World Bank’s Multi-Tier Framework and the Global Solar Atlas approach energy-access prioritisation.

2.1.2 At minimum, the model must incorporate: local solar intensity/irradiance data, an estimate of local electricity price (or the cost of the incumbent alternative, e.g. diesel generation or kerosene), and the system cost/performance output of Subtask 1. The team is encouraged to add further factors (population density, distance to existing grid infrastructure, presence of anchor loads such as clinics or schools).

2.1.3 A specific and mandatory sub-topic is grid connectivity status: does the model treat off-grid and weak-grid (unreliable, low-capacity connection) locations the same way, or does it explicitly test and justify whether micro-grids are more or less valuable in regions with no grid connection at all versus regions with an unreliable connection?

2.1.4 Institutional stability is a required factor in the score – the team must justify how they have captured the stability of local organisations (e.g. government, utility, NGO, or community cooperative) that would own, operate, or maintain the system, and how this affects the weighting of a location’s overall Impact Score.

2.1.5 The mandatory output is a geographic overlay map (e.g. built in Python with GeoPandas/Folium, QGIS, or similar) showing Impact Score by location across the target region(s), alongside the ranked list of highest-impact deployment sites and the reasoning behind the ranking.

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2.1.6 The scoring methodology should be sensitivity-tested – show how the ranking of locations changes if key assumptions (electricity price, solar resource, discount rate, institutional stability weighting) are varied, and discuss which factors the result is most sensitive to.

2.1.7 The task requires a literature review of existing micro-grid siting/impact methodologies to be completed, followed by development of the scoring model in stages as before.

2.1.8 The main assessment criterion for this subtask is the credibility and resolution of the Impact Score map produced. However, the other criteria listed for Subtask 1 are also of importance.

Timeline

The project runs to two presentation stages, and one team carries it from start to finish; there is no down-selection between the two.

The first is a mid-project review in mid-January, held online. The only deliverable is a presentation outlining the progress made thus far, and its purpose is feedback on what to optimise next.

The second stage is the in-person final presentation in March, which runs for 30 minutes and is accompanied by a report; this has a limit of 8 pages (title, contents and reference pages do not count towards the limit; nor does the appendix, which is not assessed) and should cover the concept, the method of development, evidence of initial V&V, and key lessons learned. This should be delivered 2 weeks before the final presentation. We recommend including short snippets of code in the appendix for sections of interest. The report should cover both tasks.

10 October 2026	Applications Open
25 October 2026	Applications Close
20 October 2026	Team formed
24-28 November 2026	Academic Mentor Check-In (Feedback given)
12-16 Jan 2027	Phase 1 Presentation (progress review)
20 March 2027	Final Presentation

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