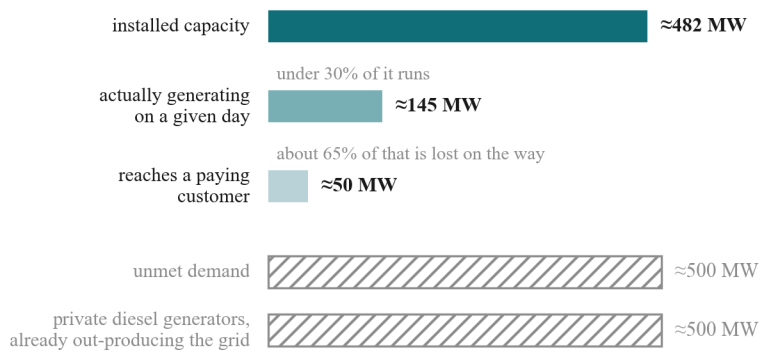


Haiti Energy Project Brief

Intuitive Understanding

Haiti has around 482 MW of power stations, but less than 30% of it generates on a given day, and roughly 65% of what is generated is lost before anyone pays for it. Private diesel generators already produce more electricity than the national grid. The money exists in principle, US\$2.4 billion in Haiti's own master plan, but nobody can say where it should go, because the evidence base to decide does not exist. This project builds it.



A the grid Haiti has

US\$2.4 bn is already in the plan.
Nobody can say where it goes.

- ① where new generation is worth the most
- ② what the existing network can carry
- ③ tools the government keeps and reruns

this project builds that evidence base

B the answer nobody has

The constraint is not capacity or capital; it is knowing where either should go.

The final presentations will be held in the House of Lords.



The House of Lords



Project Scope

Haiti has the lowest rate of electricity access in the Western Hemisphere - 53.9% of the population in 2024, against a world average of 88% [1] - and the picture behind that number is worse than the number. Installed capacity is around 482 MW, but less than 30% of it generates on a given day, lost to fuel shortages and deferred maintenance [2]; technical and non-technical losses run at roughly 65% of what is generated [2]; unmet demand is estimated at about 500 MW [2]. Private diesel self-generation, at a comparable 500 MW installed, collectively produces more electricity than the national grid does [2].

Capital and institutional will both exist in principle - Haiti's own master plan puts the 2016-2030 requirement at US\$2.4 billion, of which US\$2.2 billion is generation [3] - but neither will be committed against anything other than evidence, and that evidence base does not currently exist in a form a ministry or a financing institution can act on. Nobody can presently say with confidence where any of that money should go.

The aim is to Build the Open-Source Evidence Base for Haiti's Energy Future - optimal siting for new renewable generation, a digital twin of the existing grid, and open environmental modelling tools the government can carry forward. This project is run alongside the Haiti All-Party Parliamentary Group and in contact with the Haitian government, and its outputs are intended to be used rather than filed. This is a team project rather than a competition: three sub-projects, set out below as Subtasks 1 to 3, with one team selected to carry each of them. The three teams work closely together on a single evidence base rather than on competing entries.

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 siting model in Subtask 1 is only as good as the picture of the existing network built in Subtask 2, and both depend on the environmental data handled in Subtask 3.

This project is off the beaten track, and teams will be guided by members of academia throughout the year.

Subtask 1 - Renewable Energy Siting and the Investment Case

1.1.1 This task is to build an open-source tool that identifies the optimal locations for new renewable generation across Haiti. Open source is a requirement here rather than a preference - the code, the data sources, and the methodology must all be publishable and runnable by a third





party with no licensed software and no access to the team.

1.1.2 The resource side must be modelled from the best open data available, with the provenance and vintage of every dataset recorded. The reference sources are the Global Solar Atlas for irradiance (GHI, DNI and GTI at 9 arcsec, nominally 250 m; PV output and air temperature at 30 arcsec, nominally 1 km) [4] and the Global Wind Atlas 3.0 for wind (microscale downscaling onto a 250 m grid at 50, 100 and 200 m, from 3 km mesoscale simulations) [5], both World Bank and ESMAP products under CC BY 4.0; terrain from the Copernicus DEM GLO-30 at 30 m [6], remembering that it is a surface model and includes vegetation and buildings; and land cover from ESA WorldCover at 10 m [7]. Teams working at a coarser resolution than these should say why.

1.1.3 Safety and security must be modelled explicitly as a siting factor. Proximity to conflict-affected and gang-controlled areas, road access, and the practical ability to build and then maintain an asset at a given location all belong in the score. ACLED is the standard source and is one of the few that codes Haitian gang violence as political violence rather than ordinary crime [8]; IOM's Displacement Tracking Matrix covers the resulting population movement [9]. Note the trap, because it decides the architecture: ACLED's terms of use forbid redistributing its data or using it to build a derived dataset, so the security layer must reference and reproduce from ACLED, never embed it in what is published. Design around that from the start rather than discovering it at handover.

1.1.4 Every candidate site needs a costed financial projection: capital cost, operating cost, expected generation, tariff or displaced-fuel value, and the resulting cash flow across the asset life. The figures of merit must be the ones investors actually ask for - internal rate of return, net present value, levelised cost of energy, and payback period - with the discount rate stated explicitly. The revenue side has real numbers to anchor against: EDH's September 2023 tariffs are 22.30 gourdes/kWh residential, 31.84 commercial and 32.41 industrial (roughly US\$0.17, US\$0.23 and US\$0.24) [10], while the average cost of generation has been estimated at US\$0.32-0.39/kWh [11]. For much of the country the honest comparator is not the tariff at all, but the diesel self-generation a site would displace.

1.1.5 Quantified social impact is a required output alongside the financial return - people connected, clinics and schools served, diesel and kerosene displaced, hours of reliable supply gained - expressed in defensible units rather than adjectives, with the method used to arrive at them documented so that a sceptical reader can check it. Haiti's health facilities are already mapped: PAHO and the WHO publish their locations, categories and types through the





Humanitarian Data Exchange [12], so “clinics served” is a count, not an adjective.

1.1.6 The output is a ranked and mapped shortlist of at least ten sites: a geographic overlay (e.g. built in Python with GeoPandas or Folium, or in QGIS) showing the siting score across the country, alongside the ranked list of priority sites, the financial and social case for each, and the reasoning behind the ranking.

1.1.7 The scoring methodology should be sensitivity-tested - show how the ranking changes if key assumptions (capital cost, discount rate, resource data, security weighting) are varied, and discuss which factors the result is most sensitive to.

1.1.8 The primary assessment criterion is whether the output could be put in front of a financing institution and defended. 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 siting methodology or the scoring approach.
- f) First phase presentation.
- g) Final presentation and summary report.
- h) Cross-functionality working and integration between teams.
- i) Depth of research.
- j) Realism of the underlying cost, resource, and security assumptions.

1.1.9 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 will be assessed when the team for each subtask is selected. 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 - The Existing System: Digital Twin, Demand, and the Economics Around It

2.1.1 Investment in a network nobody understands is investment wasted. This task builds a digital twin of Haiti's existing electricity network so that bottlenecks can be identified and any money that does arrive is directed at the constraints that actually bind. The utility is EDH (Électricité d'Haïti); the regulator is ANARSE, created by decree in 2016 [13]; and the main grid is currently supplied by a thermal independent power producer and the Pélégre hydropower plant.

2.1.2 The inputs are satellite data - VIIRS Day/Night Band monthly cloud-free composites at 15 arcsec (nominally 500 m) from the Earth Observation Group, which are public domain [14], together with Sentinel-1 SAR and Sentinel-2 optical imagery at 10 m for identifying infrastructure [15] - combined with whatever in-grid sensor and utility telemetry can be obtained from EDH, fused into a single, versioned network model. One specific warning about VIIRS here: Haiti is cloudy, and a zero in the average radiance band does not mean no light was observed. Teams must carry the cloud-free coverage band alongside it or they will end up mapping cloud rather than electrification.

2.1.3 The twin must be a network model rather than a map - nodes, edges, capacities, and a power flow that can actually be solved - so that loading, losses, and voltage can be evaluated.

2.1.4 Uncertainty is a specific sub-topic here: much of the input will be inferred rather than measured, and teams must carry that uncertainty through to the outputs and attach a stated confidence to every identified bottleneck. A confident wrong answer is worse than useless here.

2.1.5 The required output is a ranked list of bottlenecks and constraint points, each with the investment that would relieve it and the benefit that would follow - expressed in the same financial and social terms used in Subtask 1, so that grid investment and new generation can be compared on an equal footing.

2.1.6 We would like to see evidence of validation against whatever ground truth can be obtained: utility records, outage reports, published network diagrams, or contacts on the ground. Where no ground truth exists, teams should say so plainly and state what would be needed to get it.

2.1.7 The task requires a literature review of existing grid-mapping and digital twin work from earth observation data, and specifically of Gridfinder (Arderne et al., Nature Scientific Data, 2019), which infers medium-voltage networks from night-time lights and OpenStreetMap





road networks and is validated at roughly 70% accuracy at 1 km [16]. Its global output covers Haiti and is published by the World Bank and on Zenodo. That is the baseline this task has to beat: teams should say by how much, and how they know. The twin itself should then be developed in stages as before.

2.1.8 A load and demand model belongs in the twin, not as an optional extension. There is no reliable metering, billing, or census data to build on - only about 55% of the electricity generated was even invoiced in 2019 [2] - so demand must be constructed bottom-up: settlement and population (WorldPop publishes Haiti at 100 m) [17], economic activity proxies, appliance ownership by income band, and the registries of health facilities, schools, and water pumping. The output is estimated load for each of Haiti's 140 communes with explicit error bars, on the OCHA administrative boundaries, which derive from the Haitian government's own CNIGS [18]. A network model carrying an assumed demand is a model of nothing, and the same load atlas is what Subtask 1 must site against.

2.1.9 Tariffs, subsidies, and cost recovery must be modelled alongside the physical network. Teams should build EDH's cost stack - fuel, operations and maintenance, technical and non-technical losses, and debt service - against tariff scenarios including a lifeline block for low-income households, cost-reflective upper bands, and prepayment, and report cost recovery, the residual subsidy landing on the treasury, and the distributional effect across income deciles. The starting position is documented: average revenue is around a third of the average cost of generation, EDH's losses have run at roughly US\$200 million a year (about 4% of the national budget), the government subsidy is of the order of US\$250 million a year, and the poorest households receive about 1.6% of it [2]. There is also a currency mismatch worth modelling explicitly, in that fuel is bought in US dollars while revenue is collected in gourdes. This is the question the IMF and the financing institutions ask first: a bottleneck that cannot be paid for is not a bottleneck that will be relieved.

2.1.10 Household energy beyond the wires is in scope, and specifically the charcoal and fuelwood economy. Woodfuels are about 80% of Haiti's primary energy supply and over 90% of households cook with wood or charcoal [19]; national charcoal consumption is around 2.2 million tonnes a year, Port-au-Prince charcoal sales alone are worth some US\$182 million a year [19], and household air pollution is associated with roughly 8,000 premature deaths annually. Teams should model the transition to cleaner cooking - liquefied petroleum gas, improved stoves, and electric cooking where a grid or mini-grid reaches - against household affordability (an improved charcoal stove costs about US\$10-30, an LPG stove with tubing and canister





US\$50-120), import exposure, the health burden of indoor smoke, and the avoided land degradation, which closes the loop with the deforestation and watershed work in Subtask 3. One caution, because it is the most common error made about Haiti: the familiar claim that charcoal has left the country with 2% forest cover is wrong. Recent land-cover work puts tree cover at around 30% [20], and the charcoal comes largely from managed coppice agroforestry rather than from clearing forest [21]. A model built on the myth is one the Haitian government will not recognise. Electrification modelled on its own describes only a fraction of the energy Haitians actually use.

2.1.11 The main assessment criterion for this subtask is the fidelity and the honesty of the twin - how much of the real network it captures, and how clearly it distinguishes what is measured from what is inferred. However, the other criteria listed for Subtask 1 are also of importance.

Subtask 3 - Open-Source Environmental Modelling Tools

3.1.1 This task builds open-source environmental modelling tools that the Haitian government and its partners can use for decisions well beyond this project - deforestation and land degradation, watershed and flood risk, hurricane exposure, and coastal and seismic hazard.

3.1.2 Teams should select three environmental questions with an identified user behind each, and model those properly, rather than modelling everything shallowly. Fewer tools that are actually used beats a suite that is not.

3.1.3 The tools must be usable by a non-specialist: documented, installable, with worked examples and sample data, released under a permissive licence in a public repository. The test we will apply is whether an analyst at CNIGS or ANARSE could run it unaided.

3.1.4 The tools must interoperate with Subtasks 1 and 2 - environmental constraints should feed the siting score, and hazard exposure should feed the resilience assessment of the grid twin. Teams should agree the data formats between the three sub-teams early.

3.1.5 Data provenance is a specific sub-topic here: every dataset used must be licensed for the Haitian government's own use, with no dependency on a subscription, an academic licence that expires, or a team member's personal account. The following are known to clear that bar and are the expected starting set: Hansen Global Forest Change v1.13 at 30 m for tree cover loss since 2000 [22]; the JRC Global Surface Water dataset, 1984-2024, for water extent and flood history [23]; IBTrACS v04r01 for tropical cyclone tracks, which NOAA states may be redistributed





without restriction [24]; the Copernicus DEM GLO-30; ESA WorldCover; WorldPop; and the OCHA administrative boundaries. ACLED, by contrast, does not clear it - see Subtask 1. Every other source must be checked against the same test and the result recorded, because a tool that cannot legally be handed over is not a deliverable.

3.1.6 We would like to see evidence of validation against observed events, with the model's performance reported honestly rather than only where it did well. There are good targets to hand: Hurricane Matthew struck the southern peninsula in October 2016 and tree cover loss there that year ran some 1,200% above the average of the preceding decade, which any deforestation or hurricane-exposure model ought to reproduce; the 2010 and 2021 earthquakes are the obvious seismic cases [25].

3.1.7 A handover plan is required: who receives the tools, in what form, with what training, and who maintains them afterwards. The natural recipient is CNIGS, the Centre National de l'Information Géo-Spatiale, which is Haiti's public repository for geospatial data and already runs an open GeoNode platform at haitidata.org [26]; ANARSE is the counterpart for anything touching the energy sector. This should be agreed with the project's institutional contacts rather than assumed.

3.1.8 The main assessment criterion for this subtask is whether the tools would plausibly still be in use a year after the project ends. However, the other criteria listed for Subtask 1 are also of importance.





Timeline

The project runs to two presentation stages. The first is in mid-January, wherein each team presents the progress made on its subtask; from these, one team is selected to carry each of the three subtasks through the rest of the year. Members of teams not selected can apply to join the selected team on the subtask they have been working on.

Teams meet their academic mentors fortnightly from the end of October, with formal check-ins in late November and early February. These sessions are part of the project rather than an optional extra, and teams are expected to come to them with specific questions and something to show.

The second stage is the final presentation in March, which runs for 30 minutes and is accompanied by a report. The report 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. It should be delivered 2 weeks before the final presentation, as a single joint submission covering all three subtasks. We recommend including short snippets of code in the appendix for sections of interest.

6 October 2026	Applications Open
25 October 2026	Applications Close
20 October 2026	Teams formed
From 26 October 2026	Fortnightly academic mentor sessions begin
24-28 November 2026	Academic Mentor Check-In
12-16 January 2027	Phase 1 Presentations (one team selected per subtask)
9-13 February 2027	Academic Mentor Check-In
20 March 2027	Final Presentations

References

[1] World Bank, “Access to electricity (% of population) – Haiti,” World Bank Open Data, 2024. [Online].





Available: <https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS?locations=HT>

- [2] Energy Access Alliance, “Deep-Dive Analysis: Electrification in Haiti,” 2025. [Online]. Available: <https://energyalliance.org/wp-content/uploads/2025/05/LAC-UAC-Haiti-Deep-Dive.pdf>
- [3] Électricité d’Haïti, “Electricity Master Plan – EDH Financial Recovery Plan,” Mar. 2017 (as cited in [2]).
- [4] Global Solar Atlas, World Bank Group / ESMAP / Solargis. [Online]. Available: <https://globalsolaratlas.info>
- [5] Global Wind Atlas 3.0, Technical University of Denmark (DTU) / World Bank Group / ESMAP / Vortex F.d.C. [Online]. Available: <https://globalwindatlas.info>
- [6] Copernicus DEM GLO-30, European Space Agency / Airbus Defence and Space, 2022. [Online]. Available: <https://spacedata.copernicus.eu/collections/copernicus-digital-elevation-model>
- [7] D. Zanaga et al., “ESA WorldCover 10 m 2021 v200,” 2022, doi: 10.5281/zenodo.7254221.
- [8] Armed Conflict Location & Event Data Project (ACLED). [Online]. Available: <https://acleddata.com>
- [9] International Organization for Migration, “Displacement Tracking Matrix (DTM) – Haiti.” [Online]. Available: <https://dtm.iom.int/haiti>
- [10] Boston University Institute for Global Sustainability, “Assessment of Haiti’s Electricity Sector,” Mar. 2018 (2015-baseline EDH tariff figures; the brief’s Sept. 2023 gourde figures were not independently verified against this or any other public source – flagged for Nick to confirm).
- [11] Boston University Institute for Global Sustainability, “Assessment of Haiti’s Electricity Sector,” Mar. 2018.
- [12] PAHO/WHO, “Health facilities – Haiti,” Humanitarian Data Exchange. [Online]. Available: <https://data.humdata.org>
- [13] “Décret régissant le secteur de l’énergie électrique d’Haïti” (decree establishing ANARSE), Le Moniteur, Feb. 3, 2016.
- [14] NOAA/NASA Earth Observation Group, “VIIRS Day/Night Band Nighttime Lights,” Payne Institute, Colorado School of Mines. [Online]. Available: <https://eogdata.mines.edu>
- [15] European Space Agency, “Copernicus Sentinel-1 / Sentinel-2 Missions.” [Online]. Available: <https://sentinel.esa.int>
- [16] C. Arderne, C. Zorn, C. Nicolas, and E. E. Koks, “Predictive mapping of the global power system using open data,” Sci. Data, vol. 7, art. 19, 2020, doi: 10.1038/s41597-020-0347-4. (Published 2020; the brief’s in-text “2019” appears to be the dataset’s Zenodo release year rather than the journal publication year – flagged for Nick to confirm which he intends to cite.)
- [17] WorldPop, “Haiti 100 m Population,” University of Southampton. [Online]. Available: <https://www.worldpop.org>
- [18] UN OCHA, “Haiti – Subnational Administrative Boundaries,” Humanitarian Data Exchange, sourced from CNIGS. [Online]. Available: <https://data.humdata.org>
- [19] A. M. Tarter and B. Coello, “Charcoal in Haiti: A National Assessment of Charcoal Production and Consumption Trends,” World Bank, Washington, DC, 2018. (Reports Port-au-Prince market value ≈US\$182M/yr, matching the brief; reports national consumption ≈946,500 t/yr, not the brief’s 2.2 million t/yr – flagged for Nick to confirm the higher figure’s source.)





- [20] A. C. Churches, J. M. Wampler, W. Sun, and A. J. Smith, “Evaluation of forest cover estimates for Haiti using supervised classification of Landsat data,” *Int. J. Appl. Earth Obs. Geoinf.*, vol. 30, pp. 203–216, 2014, doi: 10.1016/j.jag.2014.01.020.
- [21] A. Tarter et al., “Discussion of forest definitions and tree cover estimates for Haiti,” *Proc. Natl. Acad. Sci.*, vol. 116, no. 13, pp. 5910–5911, 2019, doi: 10.1073/pnas.1901163116.
- [22] M. C. Hansen et al., “High-Resolution Global Maps of 21st-Century Forest Cover Change,” *Science*, vol. 342, no. 6160, pp. 850–853, 2013, doi: 10.1126/science.1244693.
- [23] J.-F. Pekel, A. Cottam, N. Gorelick, and A. S. Belward, “High-resolution mapping of global surface water and its long-term changes,” *Nature*, vol. 540, pp. 418–422, 2016, doi: 10.1038/nature20584.
- [24] K. R. Knapp, M. C. Kruk, D. H. Levinson, H. J. Diamond, and C. J. Neumann, “The International Best Track Archive for Climate Stewardship (IBTrACS),” *Bull. Amer. Meteorol. Soc.*, vol. 91, pp. 363–376, 2010, doi: 10.1175/2009BAMS2755.1.
- [25] U.S. Geological Survey, “Search Earthquake Catalog.” [Online]. Available: <https://earthquake.usgs.gov/earthquakes/search/>
- [26] Centre National de l’Information Géo-Spatiale (CNIGS), GeoNode. [Online]. Available: <https://haitidata.org>

