



The KCL Cool Coconuts

PROBLEM STATEMENT

Describe the specific energy-related challenges faced by the communities in your target area.

Comments should be factual, objective, and non-offensive. Please remember that they may be read by the related person

Do not use ChatGPT tools or similar AI tools. While AI tools like ChatGPT can be utilized for brainstorming purposes, it is crucial that your final submission is distinctly your own.

According to the Macrotrends dataset, Tamale, Ghana, is one of Western Africa's fastest-growing cities, with a population of 811 000 and a 3.4% increase from 2025. As Northern Ghana urbanises, its power grid has come under heavy stress. This has left households, businesses, and schools facing regular blackouts. Tamale's power grid is managed by the Northern Electricity Distribution Company (NEDCo). While NEDCo has brought power to rural Ghana and covers approximately 64% of its landmass, many of its transformers and switchgear are decades out of date, and its long-distance power lines are vulnerable to vandalism and failures. Communities in the Tamale Metropolitan Area could benefit greatly from a reliable Energy grid for everyday and professional use. The Ghanaian government and NEDCo are working to improve Power Grid efficiency through international grants (\$13.44 million grant agreement with the Japan International Cooperation Agency (JICA)). It is also looking at sustainable alternatives like the "Solar for Schools" mandate. Tamale is also one of the hottest cities in Ghana, with daily high temperatures regularly exceeding 36°C in its hottest months. Schools suffer heavily from the heat because of their metal-roof construction, and indoor temperatures can reach over 40° inside classrooms. Existing cooling often relies on natural ventilation, which fails at these extreme temperatures. These temperatures make it hard for students to concentrate and for teachers to teach effectively, linking lack of reliable cooling systems directly to educational outcomes. Therefore, an effective solution would have to run on off-grid energy and be affordable to operate and maintain locally.

PROPOSED SOLUTION (OUTLINE YOUR INNOVATIVE SOLUTION TO THE IDENTIFIED PROBLEM STATEMENT. INCLUDE THE FOLLOWING DETAILS:):

What is the primary renewable energy source used?

Solar

Describe the primary renewable energy sources utilized (e.g., solar, wind, biomass) and justify your choice.

Comments should be factual, objective, and non-offensive. Please remember that they may be read by the related person

Do not use ChatGPT tools or similar AI tools. While AI tools like ChatGPT can be utilized for brainstorming purposes, it is crucial that your final submission is distinctly your own.

We chose solar energy because sunlight is abundant across most African regions, making it a sustainable and reliably available energy source. In West African nations such as Ghana, there is an average of over nine hours of sunlight per day during peak months such as November, December and January.

Give technical details how the proposed solution will work.

Comments should be factual, objective, and non-offensive. Please remember that they may be read by the related person

Do not use ChatGPT tools or similar AI tools. While AI tools like ChatGPT can be utilized for brainstorming purposes, it is crucial that your final submission is distinctly your own.

We plan to use an evaporative cooling system to help cool down the classrooms. We will install cooling pads made of coconut coir on one side of the chamber. A refillable drip reservoir will be installed above the pad to ensure a constant supply of water. Next, the box fan, powered by the solar panel and MPPT controller, will be placed in front of the cooling pad, with the exhaust facing into the classroom. The cooling pad, fan and reservoir will all be placed within an

enclosed chamber. We must leave a 10-20 cm gap between the fan and the cooling pad. The device will be installed in the classroom window, with the cooling pad facing the outside and the fan's exhaust facing into the classroom. When the fan is switched on, it pulls air from the gap between it and the pad, creating a low-pressure area. This causes hot air from outside the classroom to rush into the gap. As the air passes through the soaked pad, the water absorbs heat energy from the air, making the incoming air much cooler. This cool air is then pulled into the classroom. This process repeats, creating a constant flow of cool air into the classroom. The constant water dripping onto the coir can potentially result in mould and bacteria forming on the pads. As a result, the coir cooling pads would need to be replaced every 2-3 weeks to ensure no bacteria or mould can grow on the coir. Furthermore, the classroom must have an exhaust, such as an open window or door, to ensure humidity does not rise too high.

List and explain the major components, necessary materials and technologies needed for your solution. Are these available locally?

Comments should be factual, objective, and non-offensive. Please remember that they may be read by the related person

Do not use ChatGPT tools or similar AI tools. While AI tools like ChatGPT can be utilized for brainstorming purposes, it is crucial that your final submission is distinctly your own.

Box fan (150 Watt, 50x50 cm): We chose a box fan for our design due to its large surface area, low cost, and airflow capabilities. A 50 cm box fan is typically rated at 1,000–3,000 m³/h, which is ideal for our evaporative cooling needs. A 150W box fan running continuously consumes 0.15 kWh per hour. This means that over a typical school day, it will consume around 1.2 kWh. Its slim design allows it to be seamlessly installed onto most classroom windows. Furthermore, this fan is mass-produced in regions surrounding the capital city, Accra, making it readily available at an affordable cost. Cooling pads (coconut coir) Cellulose paper is commonly used in fan-pad cooling systems. However, we chose coconut coir because it is naturally absorbent and readily accessible in Ghana. Research by Alam et al. (2017) also found that coconut-coir pads achieved a maximum cooling efficiency of 85% and reduced the air temperature by up to 4°C. 300W solar panels: The solar panels will power the box fan. 300W solar panels are the most optimal choice as they provide enough capacity to run the fan while accounting for real-world losses. This solar panel will comfortably power the box fan, even when output varies due to external factors such as cloud cover, dust buildup, and time of day. MPPT charge controller: An MPPT controller needs to be placed between the solar panel and the DC fan. This extracts as much power as possible from the PV unit and safely converts the voltage to what the fan requires. Water reservoir and frame: Locally available Water: Locally available

What will be your primary efficiency metric?

Productive output increase (e.g., irrigation area, cold storage)

Highlight what makes your idea unique compared to existing renewable energy solutions.

Comments should be factual, objective, and non-offensive. Please remember that they may be read by the related person

Do not use ChatGPT tools or similar AI tools. While AI tools like ChatGPT can be utilized for brainstorming purposes, it is crucial that your final submission is distinctly your own.

Our solution is unique because we are using agricultural cooling methods for educational purposes. We also chose locally available, biodegradable materials such as coconut coir. Unlike conventional air-conditioning, our system does not require refrigerants and uses significantly less electricity, allowing it to be powered by a 300W solar panel. It is specifically designed to be cheap and easy to install and maintain using locally available products. Our system requires minimal user interaction; users would only need to add water to the reservoir when it's running low. The system can also be combined with passive cooling measures, such as planting trees for shade or improving roofing materials, to reduce classroom temperatures while minimising additional energy.

Describe what your financial model will look like and how the project will sustain itself beyond initial funding

Comments should be factual, objective, and non-offensive. Please remember that they may be read by the related person

Do not use ChatGPT tools or similar AI tools. While AI tools like ChatGPT can be utilized for brainstorming purposes, it is crucial that your final submission is distinctly your own.

Initial funding would aid in developing and testing our system. Successful results would help attract funding from local government, NGOs, and education organisations, which would be used as one-time payments for installation. Local schools would handle minor maintenance, such as refilling the water reservoir and replacing coconut coir every 2-3 weeks. We decided not to implement batteries into our design to allow for a longer lifecycle. Most affordable batteries, such as lithium-ion and Gel batteries, are heat-sensitive and are not suitable for Ghana's extreme heat, meaning they can degrade and corrode much more quickly, resulting in frequent battery changes. This results in higher operational costs and can lead to an unsustainable long-term financial plan. Furthermore, using coconut coir as a cheaper alternative to other materials helps lower long-term costs. This is because coir can be sourced from local vendors at affordable prices. This also helps in keeping operational costs low and sustainable. In summary, the cost per classroom can range from £250 to £400, depending on quality and local import prices. The cost to run the system is around £20 a year, which is mainly due to cooling pad replacement and other general maintenance.

ENVIRONMENTAL IMPACT

Explain how your solution minimizes environmental impact during its lifecycle, from production through usage to disposal.

Comments should be factual, objective, and non-offensive. Please remember that they may be read by the related person

Do not use ChatGPT tools or similar AI tools. While AI tools like ChatGPT can be utilized for brainstorming purposes, it is crucial that your final submission is distinctly your own.

Our evaporative cooling system uses simple, sourced materials, including coconut coir for the cooling pad, which maintains the same evaporative effects as industrial cellulose paper but promotes local supply chains and cuts costs. The solar panel will be imported, so its manufacturing and transportation create

emissions. However, the panel's lifespan is 25-30 years, during which it generates renewable electricity without further emissions. Box fans and MPPT Charge controllers are manufactured locally around the capital city. This avoids additional shipping costs and reduces CO2 emissions. At the end of their life, the panels can be recycled. The system does not contain a battery. This reduces cost and waste. A battery would have to be removed and replaced after a certain amount of time, but our solution avoids disposing of the battery at the end of its lifecycle. The system's simple design uses a reusable water basin and fan, which can be repaired individually instead of replacing the entire system. Water use is minimal, and non-drinking water could potentially be used to conserve clean water for communities. The coconut coir must be replaced every 2–3 weeks to prevent mould and bacteria from spreading through the air. However, it is locally produced and inexpensive to replace. Used coir can also be composted because it is biodegradable, completing the life cycle. At the end of its life, the system can be disassembled, and the frame, fan and solar components can be reused or recycled.

Discuss specific design elements or practices that make your solution environmentally friendly.

Comments should be factual, objective, and non-offensive. Please remember that they may be read by the related person

Do not use ChatGPT tools or similar AI tools. While AI tools like ChatGPT can be utilized for brainstorming purposes, it is crucial that your final submission is distinctly your own.

We chose a low-power DC fan for our system, which uses less electricity than conventional air conditioning and can run on a 300W solar panel. This makes it suitable for the schools that we are targeting, as they depend on an unreliable energy grid. It is considerably more sustainable than other off-grid alternatives like diesel generators, as it produces no carbon emissions. The fan can be connected directly to the PV unit through a charge controller, so we opted not to use a battery for our system. Lithium production is harmful to the environment, and a battery unit would degrade faster in the dry and hot environment of Northern Ghana. Using evaporative cooling instead of conventional air conditioning eliminates the need for refrigerant, which can cause significant greenhouse gas emissions if leaked. The cooling pad is made from coconut coir, which is a byproduct of other agricultural processes in Ghana, making it locally sourced and reducing transport emissions. The coir is also biodegradable and can be composted after use.

SOCIAL IMPACT

What is the primary impact area of your solution?

Education & Awareness

Approximately how many people will your solution serve?

Over 10,000

Illustrate how your proposal will improve the quality of life for low-income communities.

Provide specific examples of expected benefits. Comments should be factual, objective, and non-offensive. Please remember that they may be read by the related person

Do not use ChatGPT tools or similar AI tools. While AI tools like ChatGPT can be utilized for brainstorming purposes, it is crucial that your final submission is distinctly your own.

Tamale regularly records dry season temperatures between 38°C and 41°C, and they are projected to rise. A JoyNews investigation featuring University of Ghana researchers documents that under-resourced schools have poorly insulated, heat-absorbing metal roofs on their classrooms. These run up to 6°C hotter than concrete ones and sometimes exceed 40°C indoors. They also have small, poorly ventilated windows that trap heat. The same report shows students experiencing headaches, fatigue, dehydration, and sometimes even heat rashes. Researchers link prolonged heat exposure to reduced concentration and impaired cognitive development in children. This directly affects academic performance and creates barriers to proper education. A specific example is the Jantong Dashie farming community school, which enrolls 150+ students from six communities. A report by Graphic Online shows these conditions in practice: 10% of pupils dropped out of school in recent months, mainly to work on family farms and partly because of extreme heat, which also forces early dismissals. Our evaporative cooling system directly targets this. Our design can lower classroom temperatures and increase ventilation. Beyond comfort, cooler classrooms mean kids can stay in class longer, learn better, and are less likely to drop out of school. This supports Sustainable Development Goal 4 set by the United Nations, which promotes inclusive and quality education for all.

Explain how you plan to monitor and evaluate the success of your project over time

Comments should be factual, objective, and non-offensive. Please remember that they may be read by the related person

Do not use ChatGPT tools or similar AI tools. While AI tools like ChatGPT can be utilized for brainstorming purposes, it is crucial that your final submission is distinctly your own.

The installation of the product will be done by trained volunteers of a non-profit organisation such as the Global Brigades, a student-led non-profit that partners with under-resourced communities, or Greening Africa Together (GATo), a network of NGOs promoting sustainable development. The volunteers will be responsible for installing the product on the classroom windows. The initial inside and outside temperatures will be measured using a thermometer and recorded before the cooling system is set up, and again 30 minutes after it is set up to ensure it is working. The volunteers will then return within the next two weeks to check on the system and record outside and inside classroom temperatures again to monitor whether the cooling fan is still working. During this visit, they will collect student and teacher feedback, perform the first coconut coir change, and instruct the teachers on how to do it themselves .

To what extent are community members involved in the design of the solution?

Comments should be factual, objective, and non-offensive. Please remember that they may be read by the related person

Do not use ChatGPT tools or similar AI tools. While AI tools like ChatGPT can be utilized for brainstorming purposes, it is crucial that your final submission is distinctly your own.

The cooling system was developed after reviewing articles, interviews, and reports from local communities. We studied interviews with students, parents, teachers, and local researchers to gather as much feedback as possible. The main takeaways were the harsh classroom environment for students and teachers, including poor ventilation and extreme heat, which makes it extremely hard for them to stay focused. Teachers reported how challenging teaching can be under these conditions. Furthermore, parents claimed their children came home from school sweaty and exhausted. We contacted the School for Life organisation, which oversees schools in Ghana, including those in the Tamale metropolitan area. We asked for their opinions on the efficiency and use of our model and how they can be integrated into their specific building layouts. They reported harsh classroom conditions and noted that not all classrooms have ideal windows for our system, so it cannot be universally implemented; it must be adjusted based on window measurements. They also advised us to keep humidity minimal and suggested keeping windows or doors open on the opposite side of classrooms.

Personal information

TEAM LEAD: LUCA JANSS (LUCAAAJANSS@GMAIL.COM)

ADDITIONAL QUESTIONS

First Name

Luca

Last Name

Janss

Email

lucaajanss@gmail.com

Name of University, College, or Institution:

King's College London

Country of Residence you are studying in:

United Kingdom

Major / Field of Study:

Electronic Engineering

Current academic level

Undergraduate

Expected graduation date:

1 June, 2028

Country

United Kingdom

Gender

Male

If "Other" please specify:

N/A

Are you between 18 and 30 years old at the time of submission?

This competition is open to participants between the ages of 18 and 30, as outlined in our competition rules.

Yes

Please indicate your age:

This competition is open to participants between the ages of 18 and 30, as outlined in our competition rules. Please indicate your age so we can confirm eligibility.

18

MEMBER: ADAM ELMOSALAMY (ADAMELMOSALAMY@GMAIL.COM)

ADDITIONAL QUESTIONS

First Name

Adam

Last Name

elmosalamy

Email

adamelmosalamy@gmamil.com

Name of University, College, or Institution:

King's College London

Country of Residence you are studying in:

United Kingdom

Major / Field of Study:

Electronic Engineering

Current academic level

Undergraduate

Expected graduation date:

1 July, 2029

Country

Egypt

Gender

Male

If "Other" please specify:

N/A

Are you between 18 and 30 years old at the time of submission?

This competition is open to participants between the ages of 18 and 30, as outlined in our competition rules.

Yes

Please indicate your age:

This competition is open to participants between the ages of 18 and 30, as outlined in our competition rules. Please indicate your age so we can confirm eligibility.

19

MEMBER: ELISE CHABOUSSANT (ELISECHAB14@GMAIL.COM)

ADDITIONAL QUESTIONS

First Name

Elise

Last Name

Chaboussant

Email

elisechab14@gmail.com

Name of University, College, or Institution:

King's College London

Country of Residence you are studying in:

United Kingdom

Major / Field of Study:

General Engineering

Current academic level

Undergraduate

Expected graduation date:

1 July, 2029

Country

France

Gender

Female

If "Other" please specify:

N/A

Are you between 18 and 30 years old at the time of submission?

This competition is open to participants between the ages of 18 and 30, as outlined in our competition rules.

Yes

Please indicate your age:

This competition is open to participants between the ages of 18 and 30, as outlined in our competition rules. Please indicate your age so we can confirm eligibility.

20